VOL. 30 No. 12

BULLETIN

OF THE

TORREY BOTANICAL CLUB

DECEMBER, 1903

On Some Species of Heliconia

BY ROBERT F. GRIGGS

(WITH PLATES 29 AND 30)

Heliconia occupies in America the place in plant society that is filled by the banana and its congeners in the Old World tropics. Its anatomy is similar to that of its better-known relative. Like the banana it is a very difficult subject for the botanical collector. The parts are both thick and succulent and of such size as to make it impossible to represent the plant at all adequately on an herbarium sheet. As knowledge of plants from remote regions has been largely dependent on herbarium specimens, it is not difficult to appreciate that *Heliconia* has been an unsatisfactory genus to work on. Only once before the present study was undertaken has it been studied to any extent in the field. This fact accounts for most of the innovations suggested in the present paper.

Although the genus has been monographed several times within recent years, as far as practicable recourse was had to original literature in determination and comparison. Appended to the paper is a list of the papers consulted. It includes the original descriptions of twenty-six of the twenty-nine recognized species. Though no pretension is made to bibliographic completeness, it may serve as the beginning of a guide to anyone who desires to take up the study of the genus, as it is believed that with a few exceptions most of the important literature is cited.

All our plants, except the Porto Rican *Heliconia Borinquena*, came from a region in eastern Guatemala, which centers in Messrs. Owen and Champney's coffee *finca* Sepacuité, a few miles north of

[The preceding number of the BULLETIN, Vol. 30, No. 11, for November, 1903 (30: 571–640, *pl. 23–28*), was issued 4 N 1903.]

Senaju. From there trips were made northeastward to Cahabon and in a more easterly direction up the valley of the Oxec, a good-sized creek emptying into the Cahabon river ten miles below the town. In addition, the most abundant species at least were collected along the road from Panzos to Sepacuité. We were informed that the region had never been visited by a botanist, the nearest that one had been being Senaju, where Captain John Donnell Smith made a short stop. The mountains about Sepacuité, which is about 3,000 feet above sea-level, are heavily forested and in nearly their primeval condition. Here one species, *H. tortuosa*, is very abundant. Few of the species, however, are forest plants. Around the old Indian town of Cahabon the country has been reduced to an almost treeless, grass-grown desert, and on the edges of this desert where the woods are not very thick and yet the water-supply is sufficient, most of the species were found. Along the road from Panzos to Sepacuité much the same conditions prevail as around Cahabon.

We wish to express our thanks to the owners of Sepacuité, to Mrs. Owen especially, and to Mr. Alfred Rock, of Setzimaj, for their kind hospitality and for the very great assistance they so eagerly offered us, without which it would have been impossible to make our collections. I am very grateful to Mr. John Donnell Smith, of Baltimore, for the loan of all of his material on the genus, and to Dr. W. A. Kellerman, of the Ohio State University, for valuable criticism and suggestions. Thanks are also extended to the officers of the National Herbarium for the loan of specimens.

The references after the descriptions, *e. g.*, "*no. 258*," are to the collectors' numbers accompanying the sheets. Except where otherwise stated, all the plants are from a collection made by Mr. O. F. Cook and myself during March and April, 1902. This collection was made for the United States Department of Agriculture and is deposited in the herbarium of the department in the National Museum. The numbers of photographs cited are either serial or field numbers of the collection in the Office of Tropical Agriculture of the Department.

Key to the Groups and Species Discussed in this Paper

I. Leaves borne at intervals along an elongated stem, *i. e.*, with the habit of a *Zingiber*; mostly small (*H. psittacorum*). Subgenus STENOCHLAMYS Baker.

A. Leaves narrowly oblong, sessile, almost clasping the stem; peduncle short or absent; branch-bracts red, narrow. *H. Choconiana* Wats.

B. Leaves lanceolate or ovate-lanceolate, rounded or subcordate at the base; mostly petioled; peduncle at least as long as the rachis; branch-bracts yellow with red cheeks, broad, often subovate. *H. crassa.*

II. Leaves all borne from nearly the same point on the stem, as in *H. Borinquena* (*f. 3*); mostly very large.

A. Branch-bracts more or less spaced out on the rachis, not overlapping, except at the base (*H. Bihai*). Subgenus PLATYCHLAMYS Baker.

a. Inflorescence pendulous from a long flexible peduncle, glabrous; rachis very flexuose, internodes long, bracts narrow, red; leaves very glaucous beneath. *H. Collinsiana.*

b. Inflorescence erect.

1. Inflorescence long-peduncled.

(*a*) Branch-bracts very close together, narrow, truly distichous, horizontally extended; rachis very straight. *H. librata.*

(*b*) Branch-bracts distant, not strictly distichous; rachis very flexuose.

(1) Inflorescence scarlet, hairy, below the bases of the leaves; leaves green on both sides. *H. tortuosa.*

(2). Inflorescence orange, glabrous, with a very long peduncle which raises it up among the leaves; leaves slightly glaucous below. *H. latispatha* Benth.

2. Inflorescence sessile; rachis straight; branch-bracts narrow, distant, red and yellow, covered all over with short velvety pubescence. *H. spissa.*

3. Inflorescence sessile or very short-peduncled; branch-bracts very broad and close together, often clasping each other at the bases and concealing the stiff, straight rachis.

(*a*) Branch-bracts green with red cheeks; leaves green on both sides when well developed, very long, long-cuneate at the base. *H. elongata.*

(*b*) Branch-bracts bright orange; leaves glaucous below, at least when young, shorter, not cuneate.

(1) Stem upright; leaves turned in all directions, soon green beneath; tips of the branch-bracts acute or bluntish, somewhat incurved and involute; Guatemalan. *H. Champneiana.*

(2) Stem inclined; leaves all spread out horizontally, very glaucous beneath; tips of the branch-bracts long acuminate, recurved and revolute; Porto Rican. *H. Borinquena.*

B. Branch-bracts very close together on the rachis so as to form a compact flat spike, somewhat resembling the rattle of a rattlesnake (*H. imbricata*). Subgenus TAENIOSTROBUS Kuntze.

Inflorescence pendulous on a long peduncle; plant very large. *H. Mariae* Hook. f.

It will be noticed that in this key the species are arranged in a considerably different way from that used by former writers. Baker and Schumann divide the genus into two subgenera characterized by broad and narrow branch-bracts respectively. Under

these subgenera the species are arranged according to an artificial key. This arrangement often separates widely species which are very similar except in some unimportant character, and thus ignores the existence of natural groups smaller than the subgenus. That such groups do exist is certain, *e. g.*, that referred to under *H. Champneiana* and that to which *H. tortuosa* and *H. latispatha* belong. It is believed that their recognition will be of material assistance in the study of the genus. The delimitation of the subgenera has also been considerably emended. It is not to be denied that the shape of the branch-bracts is in a general way correlated with the relationships of the species, but it is only an accidental parallelism without much physiological importance, for there are many exceptions — species quite similar in all respects except that the branch-bracts are sufficiently different to place them in different subgenera as heretofore defined; for instance, *H. tortuosa* and *H. latispatha*. It is an undesirable character to use in a key because of the difficulty of application and the liability to error. In the inflorescences of several species the lower branch-bracts are lanceolate, while the upper are ovate and the intermediate neither one or the other. Besides, there are several species whose branch-bracts are ovate when fresh, but shrink so as to be lanceolate in the herbarium specimen.

Two of the subgenera, *Stenochlamys* and *Taeniostrobus*, are natural groups, but the third, *Platychlamys*, the name of which must of course go with the type, comprises simply the residue. Its present application can be considered only provisional. The extreme form of *Stenochlamys* (*H. psittacorum*) is very different from the members of the other two groups, but the difference is of only subgeneric importance, for these extremes shade through a series of intermediates into the other groups. This is true whatever characters are used to distinguish them, whether the width of the bracts or the habit, but the habit represents a natural difference of some physiological significance; and it seems to me to accord with the probable relationship of the plants.

In the groups with the typical *Heliconia* habit, those species with erect inflorescences have been separated from those whose inflorescences droop. The importance of this character seems not to have been appreciated heretofore because of the lack of

field study, and the descriptions of more than one species would have them with indifferently erect or drooping panicles. But it seems very probable that such inferences are the result of identifying two species as one. The ecological relations of the plants in the two cases are quite different. The bracts in the erect inflorescence are always full of water, into which numerous insects fall and decay, and in species like *H. Borinquena* the floral parts themselves are always more or less rotten. The fruit of such species ripens under water; and both flowers and fruit have the full benefit of the sun. But in the pendent inflorescence the flowers are shaded from the sun and rain by the roof-like bract above them, and are subjected to very different conditions. It is a question whether the erect-flowering species are insectivorous or not. If they are not, they would have only to utilize a food supply already present to become so. That this habit is no mere accidental peculiarity of the individual plant will be realized at once by any one who sees in the field how constantly the species adhere to it. With very rare exceptions the erect-flowering species always bear the inflorescence erect, no matter what may be the position of the stem, and vice versa. It is as constant as any character they possess.

Another character which has not received the attention it deserves is color in the inflorescence. The neglect of this is due largely to the method of dealing with dried specimens from which it is absent. My own observation in the field goes to show that it is one of the least variable characteristics of the genus. The shape of the parts, their relative size, and the presence of hair and glaucescence — these are variable and must be used carefully. But in the study of several thousand individuals of the more abundant species no variation in color was detected. The colors of the inflorescence are nearly always bright, but never delicate or such as are usually subject to variations.

HELICONIA CHOCONIANA S. Watson.

Whole plant glabrous, slender, as much as 2 m. tall: leaves reaching a length of 33 cm. and a breadth of 7 cm., oblong, acute or short-acuminate at the apex, cordate and almost clasping the stem, green on both sides: peduncle sometimes as much as 7 cm.

long, rachis flexuose, deflexed; lowest fertile bract 7 cm. long, 2 cm. broad: pedicels 12 mm. long: berries red and yellow, 9 mm. in diameter in the dry specimen.

Our plants (*no. 757*) were larger than Watson's and the peduncle is longer; otherwise they are very similar. They were growing in deep shady forests at Cherujija Oxec, about fifty miles west of the original locality.

Donnell Smith's *no. 8019*, collected by von Türckheim at Cubilquitz, Alta Vera Paz, has a peduncle as long as our plants. From this it would seem that Schumann's distinction (a sessile inflorescence) between *H. aurantiaca* and *H. Choconiana* will not hold. *H. Choconiana* is very close to *H. aurantiaca*, or at least to *H. brevispatha*, which was described as synonymous with it. The peduncles of our specimens are as long as those shown in Hooker's figure and the leaves are similar, but in his species they are broader with short petioles, not clasping. The distinction between the two should be the floral and foliar characters instead of the length of the peduncle.

Heliconia crassa sp. nov.

The habit of this plant may be said to be somewhat intermediate between the typical *Stenochlamys* and the rest of the genus. The stem elongates between the nodes so that the leaves are borne along it, as is the case in the former group; but the petioles, instead of diverging at an angle from the stem, continue in nearly the same direction, which is characteristic of the other subgenera. They have at the summit, however, a sharp bend of nearly 90°, so as to bring the blades into the same relation to the stem as is usual in *Stenochlamys*. Such a bend at the summit of the petioles was also seen in several species of the other subgenera (only among those with erect stems); but its amount was small, in no case more than 30°. When growing in shady places this species may attain a height of 2 m., but most of the plants are only about half as tall.

Leaves to 30 cm. long, 9 cm. broad, lanceolate, at the tip acute, at the base oblique or equilateral, rounded or cordate, thick, green, glabrous, and glossy on both sides; principal nerves on the upper surface 5 mm. apart — an unusual distance for so small a leaf; blades sessile or on petioles up to their own length:

inflorescence glabrous; peduncle 5–30 cm. long, pointing in the same direction as the stem, not necessarily upright; panicle about 7 cm. long, of half a dozen horizontally divaricate bracts on a flexuose vertical rachis, orange-yellow shading into orange-red on the cheeks of the bracts; the lowest bract often sterile, ascending and expanded into a greater or lesser blade, the others distant from each other by about their own depth, 3–6 cm. long, about 2 cm. wide, mostly subovate: flowers about 15 to a branch-bract, yellow, as long as the upper bracts: flower-bracts shorter than the flowers, 2–3.5 cm. long, nearly 1 cm. broad: pedicels about 1 cm. long: berries 5 mm. in diameter in the dry specimen.

Heliconia crassa is abundant on the mountains between Sepacuité and Secanquim (on the road from Cahabon to Senaju), but does not cross the divide into Sepacuité. It is oftenest found on the hot hills of the region, which are overgrown with bushes and small trees. It prefers the full glare of the sun. *Nos. 356* and *376* (type).

It is close to *H. subulata* Ruiz & Pavon; it resembles their figure closely, but on examination of the description it is found to differ in several respects. It is only a third as large as *H. subulata* sometimes grows; the leaves of that species reach a meter in length and the inflorescences 30 cm.; the panicle in *H. crassa* is erect, not pendulous; the branch-bracts are much broader, not yellow, tipped with red and not turning red in fruit; and the flowers are fewer to a bract. Its similarity to *H. subulata* suggests possible affinities with the other forms referred to *H. psittacorum* L. as varieties. It has no resemblance to *H. angusta* Vell., which has been considered a synonym of *H. subulata;* beside differences in the inflorescence, that species has leaves more than eight times as long as broad. *Heliconia Andreæsii* Kl., which has been considered another synonym of *H. subulata,* is nearer, but it also has longer leaves; its spathes are narrower, not channelled, and its flowers are very much larger, orange, and *distinctly black-tipped.* From *H. Schomburgkiana* Kl., which, however, is very inadequately described, it differs at least in the broader conduplicate branch-bracts. Eichler's variety, *spathacea,* which has been considered identical with it, has, as shown by Petersen's figure, long narrow leaves almost like the species. Petersen's variety, *gracilis,* has not been taken up by recent writers because of insufficient description; the

branch-bracts are broad like those of *H. crassa*, but no mention is made of the leaves, which would, therefore, be expected to be like those of *H. psittacorum* and very much narrower than those of the present species.

Heliconia Collinsiana sp. nov.

The few plants of this species we saw were growing in a clump at the top of a steep bank by the roadside. They were lopping over upon the surrounding shrubbery as though unable to stand alone; the leaves were spread out to catch the sun like those of *H. Borinquena* (*f. 3*).

Whole plant about 5 m. long: leaf-bases 2.75 m., petiole 1 m., blade 1.25 m.; blade oblong, gradually narrowed to the tip, obliquely cordate at the base, decidedly inequilateral in the type, the sides being 17 and 22 cm. respectively, bright green above, below very glaucous, with a little fine fuzzy pubescence on the midrib, otherwise glabrous: inflorescence bright red, glabrous, 45 cm. long, pendent on a slender peduncle 30 cm. long; branch-bracts lanceolate, the lowest linear-lanceolate, gradually narrowed to a blunt tip, very distant on the very flexible but slightly flexuose rachis, lowest 30 cm. long, 4 cm. broad, those half way up 15 cm. long and 3 cm. broad: flowers and their bracts not seen; few flowers (less than a dozen) to a branch-bract: pedicels 15–25 mm. long: berries 15 mm. in diameter when fresh.

On the bank of the Cahabon river about five miles below the ford by which the road crosses to the town of Cahabon (*no. 352*). It gives me great pleasure to name this species after my friend and associate, Mr. G. N. Collins; but for his pointing it out to me I would have ridden by without seeing it.

Donnell Smith's *no. 2102* from Masagua, Escuintla, is probably the same species. The leaf with his specimen is only 52 cm. long, 25 cm. wide, ovate and green below; its slender petiole, however, shows that it is not one of the large leaves of the plant, but from one of the small lateral suckers whose leaves are always shorter than those of the main stem. The same fact may also explain the absence of glaucescence, but the whole group is very variable in that respect. The inflorescence of this specimen resembles that of the type closely, but the branch-bracts are somewhat broader and each has more flowers.

According to the artificial key given by Schumann *Heliconia Collinsiana* could belong only with *H. pulverulenta* or *H. glauca*,

but it is very different from both. *H. glauca* has a red rachis, pedicels and fruit, combined with green bracts and flowers. *H. pulverulenta* belongs to *Stenochlamys;* its peduncle is not drooping, the inflorescence is much smaller with fewer bracts, the rachis straighter and the bracts closer. The relationships of the present species are more probably with *H. pendula.* Donnell Smith's *no. 4635,* which was doubtfully labelled as that species by Baker, is closely related to the present plant but has a very hairy inflorescence and differs in other characters. It seems, however, to differ from *H. pendula* also. The present species differs obviously from the latter in the glabrous inflorescence and the longer branch-bracts.

Heliconia librata sp. nov.

At the time of our visit this species had passed its season and, though many plants were observed, none were seen with fresh flowers; the inflorescences of all were dead and dry like the type, which was in the same condition when collected as now. The habit of the plant is like that of *H. latispatha,* which the present plant resembles much in all respects except the inflorescence. It is erect in all its parts.

About 3 m. tall: stem 75 cm. long: petioles 90 cm. long; blade 115 cm. x 25 cm., oblong-elliptical, rounded and abruptly short-acuminate at the base, acute or slightly acuminate at the tip, glabrous, glaucous below: inflorescence on a very long (75 cm.) erect peduncle, green according to the statement of the Indians, triangular in outline, almost as broad as long, composed of 12–16 bracts about a centimeter apart, most of them extended at right angles to the straight rachis; type inflorescence glabrous except for a few hairs on the rachis; branch-bracts (except the upper) lanceolate, the lowest sterile, 20 cm. long, 4 cm. broad, with a small lamina at its tip; largest of the fertile bracts about half as long but of the same width, the topmost only 3 cm. long: pedicels 10–15 cm. long.

Heliconia librata is a lowland form, abundant in the upper part of the Oxec valley, but does not occur in any other region we visited (*no. 696,* Cherujija Oxec).

According to the artificial keys it belongs in Baker's section *Stenochlamys* and would be nearest to *H. glauca,* which it scarcely resembles even in general appearance and differs from sufficiently, as far as characters go, in having the leaves more than twice as

large, the internodes of the rachis shorter and the bracts more numerous. The relatively short rachis and the long peduncle, with the comparatively large number of branch-bracts, suggest that this plant is near those species with a head of densely imbricated bracts for which the section *Taeniostrobus* was erected.

Heliconia tortuosa sp. nov.

Whole plant about 3.5 meters in height (trunk 1.75 m., petioles 75 cm.): leaves about a meter long, 20–30 cm. broad, rounded and oblique at the base, abruptly short-acuminate at the tip, bright green and glabrous on both sides except that the midrib, below, and the petiole bear more or less coarse matted brown hair: inflorescence brilliant scarlet, erect or nearly so; peduncle long, stiff, aligned with the stem; lowest bract often developing a large blade, sometimes nearly as large as the other leaves; rachis extremely flexuose; the few bracts (about half a dozen) distant from each other by about their own depth, not truly distichous but arranged in a sort of spiral with an angle of about 120° between them, lowest about 12.5 cm. long, 5 cm. broad; the upper nearly as large, subovate, triangular, straight-sided, not tapering, with a blunt frayed point; rachis between the upper bracts attaining its full extension almost as soon as they separate from the head formed by those above them which have not yet opened out; bases of bracts at least, and rachis covered with matted brown wool: flowers green, 5–7 cm. long, projecting above the edges of the branch-bracts; flower-bracts two thirds as long as the flowers; floral parts glabrous except for an occasional hair. (PL. 29, F. 1.)

No. 17; photographs *3610* and *4130*. *Heliconia tortuosa* is the only representative of the genus common about Sepacuité, but in the valley which the plantation occupies it is one of the most conspicuous plants; it grows everywhere except in the thickest woods where the light is too weak. Donnell Smith, *no. 1828*, Pansamalá, Alta Vera Paz, alt. 3800 feet, April, 1899. The bracts are longer and narrower than in our specimen.

Heliconia tortuosa is very similar to *H. villosa* Kl., from Colombia, or at least to the printed descriptions of it. The similarity is due, I suspect, more to lack of detail in the descriptions than to resemblance in the plants. Petersen's plate in the "Flora Brasiliensis" shows a very different plant from the present and emphasizes the discrepancies between the two. The Guatemalan species differs from the Colombian in having (1) a peduncle straight and

stiff, not curved; (2) an oblong, not a deltoid, panicle; (3) a very flexuose rachis; (4) bracts not approximated and fewer than in *H. villosa*; (5) flower-bracts glabrous, shorter than the flowers, not hirsute and of the same length; (6) flowers larger, glabrous, not hairy, pedicelled, not sessile, ovary glabrous, not pubescent; (7) leaves obliquely rounded at the base and short-acuminate at the tip, not subattenuate, alike at both ends.

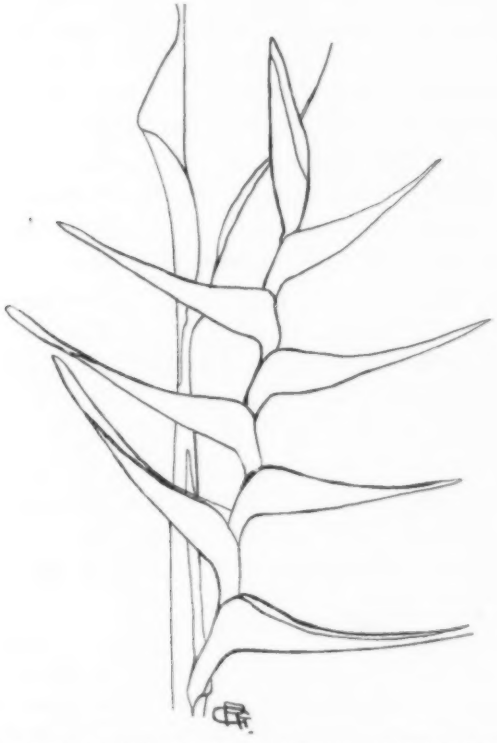


FIG. 1. *Heliconia latispatha* Bentham. Inflorescence just before anthesis. Note that though the branch-bracts are quite narrow, the flowers are not visible. Traced from a photograph by Mr. G. N. Collins (*no. 129*).

HELICONIA LATISPATHA Bentham

Whole plant about 2.5 m. tall; stem 15 cm. in circumference, green at the base but above and on the petioles covered with a thin evanescent bloom: petioles about 50 cm. long: leaf-blades 1 m. by 30 cm., short-acuminate at the tip, obliquely narrowed to

the base, glabrous on both sides except for the midrib which is somewhat hairy, slightly glaucous below: inflorescence borne at the summit of a long (60 cm.) peduncle; lowest bract, which is sterile, and sometimes the next, expanded into leaves which may attain a large size; branch-bracts 8–10, rich orange, rachis greenish-orange; bracts narrowly lanceolate; one from the middle is 15 cm. long, 3–4 cm. broad (dry): flowers very small, entirely hidden below the edges of the bracts, 30–35 mm. long, subtended by triangular-ovate bracts of about the same length and 12–15 mm. broad, pedicels apparently not pubescent as they are described in *H. latispatha* and there is no hair on any part of the inflorescence. (FIG. 1.)

Secanquim, about half way between Senaju and Cahabon (*no. 262*, photographs *128*, *129*). It is very abundant on the hillsides around Secanquim, where it occupies the same place in the plant societies as does *H. tortuosa* higher up about Sepacuité.

Donnell Smith, *no. 1829*, Rio Dulce, Dept. Livingston. In this specimen, which is more mature than ours, even good sized fruits are very short-pedicelled and barely look over the edges of the narrow branch-bracts.

The panicle is oblong in outline like that of *H. tortuosa*, to which the present plant is closely related. As in that species the branch-bracts are not truly distichous, but are only approximately opposite and the rachis is strongly flexuose. But the peduncle is much longer, so that the inflorescence though originating at about the same part of the plant is much higher up; instead of being half way down the stem it is about level with the bases of the leaves.

Heliconia spissa sp. nov.

Plant about 2 m. long, with a habit like *H. Borinquena* (*f. 3*), leaning over with its leaves all horizontal: blade 75 cm. long, 20 cm. wide, oblong-oval, acute at the tip, rounded to the base, green and glabrous except for the under side of the midrib which bears more or less coarse brown hair; main nerves only 3 mm. apart — whence the name: inflorescence practically sessile (on a peduncle only 25 mm. long), stiffly erect, thickly covered with soft short brown hair except on the edges and channels of the bracts, rachis straight, hardly flexuose; branch-bracts distant from each other by more than their own depth except near the tip of the panicle, oblong-lanceolate, acute or obtuse, the lowest 17 cm. long, 1.5 cm. broad; lowest fertile bract 8 cm. long, 1.5 cm.

broad, uppermost 4 cm.; whole inflorescence bright yellow, shading to orange on the cheeks of the branch-bracts: flowers a dozen or less to the bract, about 4 cm. long, yellow, densely covered with the same soft short hair as the rest of the inflorescence, not scabrous; flower-bracts 25 mm. long, nearly 10 mm. broad, triangular acute, densely pubescent, especially on the midrib; pedicels 1 cm. long, hairy: berries (not ripe) also hairy.

Along the road from Cahabon to Senaju (*no. 359*) growing on a steep river bank a mile further east than *H. Collinsiana*. It is known to me from a single clump with only one inflorescence.

Heliconia spissa very nearly corresponds with the descriptions of *H. Schiedeana*. But they are lacking in detail except as to floral characters. The most obvious difference is in the color of the branch-bracts, which is red in that species but yellow and orange in the present.

Heliconia elongata sp. nov.

Plant generally erect in all its parts, 2–4 m. tall (type, 3.5 m. with a stem 1.5 m., petiole 0.5 m., blade 1.5 m.), glabrous: leaf elongated-oblong, only one seventh as broad (22 cm.) as long, very long-cuneate at the base, rounded to the suddenly short-acuminate tip, green on both sides; mid-rib very large and stiff, 15 mm. in diameter near the base of the leaf: inflorescence upright, without a peduncle, oblong in outline, composed of a dozen or more deeply boat-shaped bracts with clasping bases which hide the stiff, straight rachis; branch-bracts green on the edges and bottom, shading through yellowish-green to a small patch of weak, light red on the cheeks but nowhere crimson; one from the middle of the spike 13 cm. by 9 cm. (measured dry), all ovate, gradually tapering to the sharply acuminate tip: flowers 8 cm. long, bright green at the exposed tips, just projecting above the edges of the branch-bracts; segments of the perianth linear oblong; flower-bracts 5 cm. long, 2 cm. broad, triangular-ovate. (FIG. 2.)

No. 790. It grows all along the Polochic River and up into the hills to an altitude of about 2,000 feet along the road from Panzos to Sepacuité, where a few clumps of it were seen growing with *H. Champneiana*. It covers a greater area and thrives under more varied conditions than any other species studied.

Donnell Smith, *no. 1830*, "Monte Cachirulo, Depart. Yzabal, alt. 700 pp. April, 1899."

Heliconia elongata is closest to *H. humilis* but differs in stature, in the shape of the leaves and in having nearly twice as many branch-bracts, which are not nearly as highly colored, those of *H. humilis* being deep scarlet with only a narrow margin of green near the tip. It also resembles *H. rutila* (see below), but differs

FIG. 2. *Heliconia elongata* sp. nov. The type clump, showing how conspicuously erect are the inflorescences, regardless of the stem angle. Traced from a photograph.

in the narrow perianth-segment, the wider more numerous *green* and red branch-bracts and the shape of the leaves.

In studying *Heliconia elongata*, it has been necessary to determine *H. Bihai*. That species is the type of the genus and for a long time was the only one recognized. As is not unusual in monotypic genera, to the one species were referred all the Heliconias discovered for a long time. In this way *H. Bihai* became

a "composite" to which different authors referred very different plants, and consequently has been a source of much difficulty and confusion. This confusion has continued to the present time, and the recent monographers have not cleared it away but have made their descriptions so general as to include most, though not all, of the various plants described in the places they cite. To determine what *H. Bihai* really is and to limit the name to a single species is not an easy task, but it is necessary for any precision in dealing with it and the related species. In attempting to make such a determination we are aware of the great possibility of error, but we consider it less serious to commit a nomenclatorial blunder by applying the name to the wrong plant than to make the taxonomic mistake of referring several species to one. Besides it is more likely that any nomenclatorial uncertainty will be removed, if it can be, after the species themselves are differentiated.

For some reason Linnaeus in what is, for nomenclatorial purposes, the original description * in the "Species Plantarum," cited Plumier's last species (*variegata*) first. Were this determinable it would be the type of *H. Bihai*, but beyond the reference to the variegated branch-bracts we know nothing about it and there seems to be no way of finding out anything else. Therefore we reject this species from consideration and take up the next cited, one with scarlet bracts, which was Plumier's first species. The early French writers that had access to Plumier's manuscripts are united in considering that this was the species figured by Plumier and in calling it *Heliconia Bihai*. Their figures and descriptions are in substantial accord with his but add a great deal to them. Burmann, in 1756, published a plate from Plumier's manuscripts showing the whole plant and the floral parts full size. The drawings of the flowers are almost identical with those published earlier by Plumier himself, and almost certainly came from the same species. Plumier, in the earlier work, gave no hint as to which of the three species he was figuring, but the identity of his

* "MUSA spadice erecto. *Bihai.*
Bihai amplissimis foliis, florum vasculis variegatis. *Plum. gen.* 50.
Bihai. *Ovid. l.* 8, *c.* 9. [Should be lib. 7. cap. 9. — R. E. G.]
β. Bihai amplissimis foliis, florum vasculis coccineis. *Plum. gen.* 50.
γ. Bihai amplissimis foliis, florum vasculis subnigris. *Plum. gen.* 50.
Habitat in America *calidiore*."—L. Sp. Pl. 1043. 1753.

figures and Burmann's show that both were drawn from the species with scarlet branch-bracts which alone was referred to by Burmann. This *Heliconia Bihai* may be briefly described as follows:

HELICONIA BIHAI L.

Bihai florum vasculis coccineis Plum. N. Pl. Am. Gen. 50. *pl. 3.* 1703.

Musa Bihai L. Sp. Pl. 1043. 1753 (in part).

Bihai Plum. Pl. Am. ed. Burm. 49. *pl. 59.* 1756.

Heliconia Bihai L. Mant. Pl. 211. 1767 (in part). Jacq. Pl. Rar. Hort. Schoen. **1**: 26. 1797. Lam. Encyc. *pl. 148.* 1823. L. C. Richard, Nova Acta, **15**, suppl.: 22. *pl. 8, 10.* 1831.

Whole plant 3–4 m. tall, erect, glabrous: leaves subdistichous, nearly 2 m. long, 50 cm. broad, round at both ends, long-petioled: inflorescence stiffly erect; peduncle thick, as long or longer than the straight rachis, raising the inflorescence up among the leaves; branch-bracts scarlet, broadly ovate, acuminate, mostly concealing the rachis: perianth-segments narrow, oblong linear; flower-bracts ovate, acute.

The habitat of this plant is uncertain, but it probably came either from one of the French West Indies, most likely Martinique, or from Guiana.

This clears the way for the consideration of the other plants confused with *H. Bihai.* The first was described by Swartz (Obs. Bot. 96. 1791). The description is mostly of flowers and is hardly definite enough for specific determination. Its bracts, however, are different in color from those of *H. Bihai* and on that account it was renamed *H. luteofusca* by Jacquin.

In Andrews's Repository (*pl. 640*) is figured as *H. Bihai* a species with a sessile inflorescence whose bracts are purple with bright yellow edges. In general appearance it is similar to *H. humilis,* though taller. For this the name **Heliconia purpurea** is suggested.

Another so-called *Heliconia Bihai* was figured by Loddiges (Bot. Cab. *pl. 252*) and by Edwards (Bot. Reg. *pl. 374*). The plant is about 3 meters high, with few leaves and erect habit like *H. elongata.* Inflorescence sessile, upright; rachis red (visible), but little flexuose; bracts narrow, ovate-lanceolate, hardly touching each other, red with yellow margins; flower broad and short,

perianth-segments broad, flower-bracts ovate. It differs from *H. Bihai* in the habit, in the acute leaf and in the sessile inflorescence; and from *H. purpurea* in the color and width of the bracts. For this plant the name **Heliconia rutila** is suggested.

A fourth species is described by Petersen in the Flora Brasiliensis (**3**[3]: 16. *pl. 5*). This, Petersen himself believed to be different from Richard's species, but he supposed it to be the same as Swartz's, to whom he credits the name. It differs from *H. Bihai* in having acuminate glaucous leaves; a long, weak, flexible peduncle, a very flexuose rachis with internodes 3–5 cm. long; distant, narrow, branch-bracts; and triangular flower bracts. For this species the name **Heliconia distans** is proposed. As the Flora Brasiliensis is not accessible to everyone, it may be of interest to add that a reduction of Petersen's plate of *H. distans* is given in Schimper's Pflanzen-geographie, page 359.

For a summary, a key to the species confounded with *Heliconia Bihai* may be given:

Peduncle long, stiff, erect; branch-bracts red, broad, close together; leaves round at both ends, green on both sides. *H. Bihai.*

Peduncle long, flexible, curved; branch-bracts red and yellow, narrow, distant; leaves acuminate, glaucous below. *H. distans.*

Peduncle none, leaves green on both sides, acute.

Branch-bracts red and yellow, narrow, barely touching each other; perianth-segments short and broad. *H. rutila.*

Branch-bracts purple and yellow, broadly ovate, close together; perianth-segments linear. *H. purpurea.*

Heliconia Champneiana sp. nov.

Whole plant 5.5 m. tall (stem 1.5 m., petiole 1.5 m., blade 2 m.), erect: stems, petioles and blades of the leaves upright and turned in all directions, *i. e.*, tangential to circles centering in the stem: stem beset with long, straight light brown hairs projecting at right angles: leaves 2 m. long, about 50 cm. wide, tip rounded, not acute, base obliquely cordate; covered when young with a slight bloom on the under surface, which disappears with age and in drying, leaving them green and glabrous on both sides: inflorescence about 45 cm. long, oblong in outline, composed of about 9 bracts, bright orange with occasional red splashes: peduncle short and stout, not more that 25 cm. long, hairy; branch-bracts close together, hiding the rachis and touching the base of the next above them, on the other side; upper nearly uniform in shape and size, about 14 x 11 cm. (measured dry), broadly ovate,

deeply boat-shaped, slightly tapering to a blunt somewhat incurved tip; rachis straight, glabrous like the bracts; each bract very many-flowered: flowers about 7.5 cm. long, green outside, white inside, pubescent in two broad lines up the back, otherwise glabrous; flower-bracts glabrous, nearly as long as the flowers, quite broad. (PL. 30.)

No. 528; photographs *4*, *5*. *Heliconia Champneiana* was first seen on the steep mountain side up which zigzags Mr. Champney's road from Panzos to Sepacuité. Later it was observed east of Cahabon in the valley of the Oxec river. It gives me much pleasure to associate with this species the name of Mr. Kensett Champney, whose great and precise knowledge of the flora, fauna, customs and language of the country makes him an authority on all that pertains to the natural history and anthropology of Alta Vera Paz. To him we are indebted for a great deal of valuable information and for all the courtesies which he and Mr. and Mrs. Owen united to show us during our visit to Sepacuité.

Heliconia Champneiana may be taken as the type of a very compact and natural section of the genus including *H. rutila*, *H. purpurea*, *H. elongata* and *H. Borinquena*. These are all characterized by practically sessile, erect inflorescences, stiff straight rachises and by relatively broad often clasping branch-bracts.

Heliconia Borinquena sp. nov.

This species is very similar to the Guatemalan plant just described, but is somewhat smaller in all its parts. Whole plant 3–4 m. long with 3–5 leaves on petioles about 1 m. long and sheathing bases twice as long. Its habit is different from *H. Champneiana*; instead of growing erect it leans over and spreads out all its leaves horizontally. (FIG. 3.)

Leaves 1–1.25 m. long, about 30 cm. broad, rounded at the base, acute or short-acuminate at the tip, glabrous, green above, decidedly glaucous beneath: inflorescence conspicuously upright no matter what may be the position of the stem, glabrous throughout, oblong, about 30 cm. long, half as wide; branch-bracts 8–10, very broadly ovate, broader than in *H. Champneiana*, all except the lower nearly as broad as long (one from the middle of the spike measures 12 cm. both in breadth and length), closely clasping and overlapping each other at the bases so that the side of one is on a level with the bottom of the next above it, on the

same side of the rachis, much closer than in *H. Champneiana*; their tips long, subulate, recurved with revolute margins; flowers greenish, about 11 cm. long, tips projecting above the edges of the branch-bracts; flower-bracts about 9 cm. long. (PL. 29, F. 2.)

Growing on the steep sides of a wet clay ravine amid a tangle of tropical underbush, near the military road, 13 km. north of Cayey, Porto Rico (Underwood and Griggs *no. 363*, June 24, 1901; photographs *2827* and *2829*.)

Our specimens of *H. Borinquena* are, with one exception, the only representatives of the genus in the National Herbarium from

FIG. 3. *Heliconia Borinquena* sp. nov. Whole plant, showing the habit and the upright inflorescence. Traced from a photograph by Mr. G. N. Collins (*no. 2827*).

Porto Rico. The exception is Sintenis's *no. 1131* from near Bayamon, which was determined as *H. Bihai*. Since, however, that species has leaves green on the under side such a reference is probably a mistake, for the leaves of Sintenis's specimen are very glaucous below. Its leaves suggest *H. Borinquena*, for they are of about the same texture and size — as far as one can tell from the fragments preserved — but it has a long slender peduncle and the bracts are longer, narrower and triangular-ovate, without the subulate recurved tip (in the specimen).

Heliconia Borinquena and *H. Champuciana*, which is closely related to it, are easily distinguishable from the others of the group to which they belong by the orange branch-bracts, for all the others are margined with a color different from that of the cheeks.

HELICONIA MARIAE Hook. f.

This species is a giant in a genus of giants; it sometimes reaches a height of 12 meters when growing in the shade and protected from the weather. Most plants are, however, not more than two thirds as large. Its general appearance when growing in masses is strikingly similar to that of a banana plantation, though the individual plant would never, even if not in flower, be mistaken for a banana, because of the smaller number of leaves.

Leaves 2–3 m. long, about 60 cm. broad, oblong-elliptical, obliquely subcordate at the base, acute at the tip, when young covered with a slight evanescent bloom: inflorescence a dark rose-color, at the end of a long (60 cm.) nodding peduncle; bracts densely imbricated, concealing the rachis in the fresh specimen, panicle generally not much longer than broad, but sometimes very long, with very many branch-bracts; lowest fertile branch-bracts slightly reflexed, ovate, 8–9 cm. long, 7–8 cm. broad, attenuate to a blunt frayed tip, narrowed to the base, those from the middle of the inflorescence nearly orbicular when spread out, 6–7 cm. long, 7–8 cm. broad, widest at the middle, narrowed both ways to the blunt tip and base, with more or less short soft brown hair: flowers about ten to a branch-bract, their exposed tips rose, fading into white on the shielded portions, 4–5 cm. long, with flower-bracts a little shorter and sometimes at least 2 cm. broad, often conduplicate and keeled below where compressed by the surrounding flowers, part of them hairy; ovary white, turning deep blue when ripe; pedicel very variable in length.

There are some discrepancies between this plant and the descriptions of Hooker's plant, but they are mostly in size and hairiness. In more constant particulars they seem to correspond very well.

This species grows abundantly around and a little above Panzos (*no. 787*). None of it was seen along the Polochic, nor does it ascend to Sepacuité. A solitary clump was seen in the valley of the Oxec.

Beside the species already described one other was collected in the valley of the Oxec. Only one plant was seen and that

toward night when we were hurrying to reach our destination, and a part of this specimen was lost, so that it is better to pass it till another time when fuller material can be had. It was of the subgenus *Stenochlamys*, perhaps closest to *H. cannoidea* Rich., 1.5 m. tall, with seven leaves, 40 cm. long, not quite 10 cm. broad, sessile with long acute bases, acuminate at the tip; green and glabrous on both sides; peduncle a little less than 10 cm. long; inflorescence bright scarlet, about the same shade as in *H. tortuosa*, rachis deflexed, flexuose, lowest bract 17 cm. long with a small blade at the end, next 9 cm., both about 2 cm. broad (*no. 693*).

Explanation of Plates

PLATE 29

FIG. 1. *Heliconia tortuosa* sp. nov. The inflorescence, one half natural size. Photographed in the field by Mr. G. N. Collins (*no. 3610*).

FIG. 2. *Heliconia Borinquena* sp. nov. The inflorescence, one half natural size. Photographed by Mr. G. N. Collins (*no. 2829*).

PLATE 30

Heliconia Champneiana sp. nov. A portion of the type in situ showing the upright habit. (Photograph *no. 5.*)

LITERATURE CONSULTED

Andrews, H. Bot. Rep. **2**: *pl. 124.* 1800; **10**: *pl. 640.* 1812. Gives good colored plates from garden specimens of *H. psittacorum* Sw. (not L. f.) (*H. Andrewsii* Kl.) and *H. Bihai* (*H. purpurea*), with descriptions of each.

Aublet, F. Hist. Pl. Guiane Fr. **2**: 931. 1775. Describes *Musa Bihai* and *M. humilis*.

Baker, J. G. A Synopsis of the Genera and Species of Museae. Ann. Bot. **7**: 189–222. 1893. Describes *H. platystachys* and *H. Burchellii*.

Bentham, G. Bot. Sulphur, 170, 171. 1844. The original descriptions of *H. latispatha* and *H. vaginalis*; they are brief, unillustrated, and drawn mostly from variable floral characters so that they are very unsatisfactory.

Browne, P. Civ. and Nat. Hist. Jam. 364. 1756. Describes in a general way, as a *Musa*, a Jamaican *Heliconia*, but does not give sufficient material for specific reference.

Chamisso, A. von & Schlechtendahl, D. F. L. von. Linnaea, **6**: 57, 58. 1831. A brief collector's note but hardly a description of the plant afterward named *H. Schiedeana*.

Edwards, S. Bot. Reg. **5**: *pl. 374.* 1819. Gives a good colored plate of *H. Bihai* (*H. rutila*).

Ender, E. Gartenfl. **20**: 152. 1871. A notice of *H. vinosa*, with a brief description of it.

Guilmot, G. Fl. Serr. Jard. **23**: 125. *pl. 2416–17*. 1880. Figures and describes *H.? striata*. It is without flower, and is more likely than not a member of some other genus.

Hooker, J. D. On a new *Heliconia* with the habits of a *Musa*, sent from New Granada. Jour. Linn. Soc. London, **7**: 68, 69. 1863. Gives a full and complete description of *H. Mariae*, but no figure.

——— *Heliconia humilis* Jacq. Curt. Bot. Mag. III. **22**: *pl. 5613*. 1866. A good description, with a colored figure, of Jacquin's species.

Hooker, W. J. *Heliconia Brasiliensis*. Hook. Exot. Fl. **3**: *pl. 190*. 1827. Original description, full, with a good colored plate.

——— *Heliconia angustifolia*. Curt. Bot. Mag. III. **5**: *pl. 4475*. 1849. A good description, with a colored plate.

——— *Heliconia pulverulenta*. Curt. Bot. Mag. III. **7**: *pl. 4685*. 1852. Description with colored figure.

——— *Heliconia metallica*. Curt. Bot. Mag. III. **18**: *pl. 5315*. 1862. Original description, with colored figure.

——— *Heliconia brevispatha*. Curt. Bot. Mag. III. **19**: *pl. 5416*. 1863. Described as a synonym of *H. aurantiaca* Ghiesb.; a full description illustrated with a good figure.

Jacquin, N. J. Pl. Rar. Hort. Schoenb. **1**: 23. *pl. 48, 49*. 1797. Here is described *H. humilis* with two large, carefully drawn colored plates. Jacquin is the only one of the early writers that had opportunity to study the plants in the field, and consequently his descriptions are better and his conception of the relationships, number and distinctness of the species are clearer than those of his contemporaries.

Klotzsch, J. F. Beiträge zu einer Flora der Aequinoctial-Gegenden der neuen Welt: Musaceae. Linnaea, **20**: 462–466. 1847. Describes as new species *H. Meridensis*, *H. villosa*, *H. Schiedeana*, *H. Schomburgkiana* and *H. bicolor*, briefly and without figures.

——— in Schomburgk Reisen Brit.-Guiana, **3**: 815, 919, 1070, 1125, 1126. 1848. Lists, with notes of flowering, the following: *H. acuminata*, *H. Ballia*, *H. bicolor*, *H. Bihai*, *H. flexuosa*, *H. pulverulenta*, *H. Richardiana* and *H. Schomburgkiana*.

Kuntze, Otto. Rev. Gen. Pl. **2**: 684. 1891. Description of *Bihaia imbricata* and of section *Taeniostrobus*, with a list of the species, which are transferred to Kuntze's genus *Bihaia*.

Lamarck, J. B. A. P. M. Encycl. **1**: 426. 1783; *pl. 148*. 1823. Describes all the Heliconias known at that time, as he understood them, and figures *H. Bihai*.

Lindley, J. Bot. Reg. **19**: *pl. 1648*. 1834. Original description of *H. pulverulenta*, with colored figure.

Linnaeus, C. Sp. Pl. 1043. 1753; ed. 2. 1477. 1763. First binominal reference to a *Heliconia* under the name *Musa Bihai*.

——— Mant. Pl. 211. 1771. The original application of the generic name.

——— Syst. ed. 13. 204. 1774. The first description of the genus.

——— (filius) Suppl. Syst. Veg. 157–159. 1781. Describes *H. alba*, *H. psittacorum*, *H. hirsuta*.

Loddiges, C. Bot. Cab. 3: *pl. 252*. 1818. Gives a colored habit-figure of *H. Bihai* (*H. rutila*).

Merian, M. S. de. Hist. Gén. Insect. Surinam. 1: 54. *pl. 54*. 1771. Gives a description with a plate of a *Heliconia* called "Ballia" by the Indians.

Miller, P. Gard. Dict. 1739. A popular and indefinite description of "*Bihai*."

Oviedo, G. F. de. Hist. Gen. y Nat. Indias. lib. 7: cap. 9. Gives an account of a plant called "Bihas" and its uses.

Paxton, J. *Heliconia Brasiliensis*. Paxt. Mag. Bot. 3: 193. 1837. Gives a good colored figure and a habit-figure, in addition to a full description.

Petersen, O. G. Musaceae, in Mart. Fl. Bras. (fasc. 107) 3^3: 1–27. *pl. 1–8*. 1890. Describes 25 species, the new ones being *H. elegans*, *H. conferta*, *H. Wagneriana*, *H. Bourgaeana* and *H. curtispatha*.

——— Musaceae, in Engler & Prantl, Pflanzenfamilien, 2^6: 1–10. 1889.

Plumier, C. Nov. Pl. Am. Gen. 50. *pl. 3*. 1703. Describes three species of *Bihai* and figures the flower of one.

——— Pl. Am. ed. Burm. 49. *pl. 59*. 1756. A better figure and description of Plumier's plant.

Poeppig, E. Reise in Chile, Peru und auf dem Amazonstrome, 2: 295. 1836. The original application of *H. velligera*, without much description.

Regel, E. Gartenfl. 16: 90, 245. 1867. A review of the original description of *H. pendula*.—Notice of *H. humilis* Jacq.

Richard, L. C. Mus. Comm. Bot., Nova Acta. 15: suppl. 1831. A very important paper illustrated with twelve plates in which *H. Bihai*, *H. acuminata*, and *H. cannoidea* are figured.

Rodigas, E. Ill. Hort. 29: 59. *pl. 448*; 29: 155. *pl. 464*. 1882. Figures and describes *H? triumphans* and *H? aureostriata*. Both these are foliage plants without flowers, and are as likely Cannas as Heliconias, which they do not particularly resemble in habit.

Ruiz, H. & Pavon, J. Fl. Per. & Chil. 3: 70, 71. *pl. 303–305*. 1802. Describe and figure *H. subulata*, *H. lingulata* and *H. rostrata*.

Rumphius, G. E. Herb. Amboin. 5: 142. *pl. 62. f. 2*. (1695). 1747. A reference to a Musaceous plant, supposed to be a *Heliconia*, found wild in Amboyna.

Schimper, A. F. W. Pflanzen-geographie. Jena, 1898. On page 359 is given a reduced reproduction of Petersen's figure of *H. Bihai* (*H. distans*).

Schumann, K. Musaceae, in Engler's Pflanzenreich (Heft 1), 4^{15}: 1. 1900.

Sims, J. *Heliconia psittacorum* Sw. Curt. Bot. Mag. **14**: *pl. 502.* 1801. Colored plate and description of *H. Andrewsii.*

Swartz, O. Obs. Bot. 96. *pl. 5. f. 2.* 1791. Describes *H. Bihai* Sw. and *H. psittacorum* Sw. (*H. Andrewsii* Kl.), and figures the former.

Vellozo, J. M. Fl. Flumin. **3**: *pl. 19–22.* 1827. Text (Archiv. Mus. Nac. Rio Jan.), 29. 1881. Figures and describes *H. Biahij, H. angusta, H. thalia, H. episcopalis.*

Verlot, B. *Heliconia glauca.* Rev. Hort. **40**: 112. 1869. *Heliconia densiflora, l. c.* 274. Very good descriptions accompanied by colored plates.

Watson, Sereno. Proc. Am. Acad. **23**: 284. 1888. Describes *H. Choconiana.*

—— Gard. and For. **1**: 161, *f. 31.* 1888. Repeats the description, and gives a figure of the plant.

A Summary of our Present Knowledge of the Ferns of the Philippines

By Lucien Marcus Underwood

Linnaeus included a single fern from the Philippines in the first edition of his *Species Plantarum*. This was called *Adiantum Philippense* and was based on a figure of Petiver, who seems to be the sole authority for the source of the fern. Hooker referred the plant with some hesitation to *A. caudatum*, which appears to be a common species in the islands. The early European travelers collected a few ferns in the Philippines, some of which were described by Cavanilles early in the last century; the types of these species are presumably at Madrid. Chamisso included the Philippines in his travels and Kaulfuss described several Philippine ferns in his *Enumeratio* (1824). Presl described a number collected by Thaddeus Haenke and by Née in his *Reliquiae Haenkeanae* (1830) and others still from the same collectors in *Epimeliae Botanicae* (1849). Gaudichaud also visited Luzon and collected a few species. It was not, however, until 1836–40 that any considerable collection was made in the islands, when Hugh Cuming, an English botanical traveler, visited the Philippines and brought back an extensive collection of ferns which were studied by John Smith, of Kew Gardens. Smith published a list of these ferns * which included 297 species, of which he estimated that 100 were new to science. He gave names to his new species but they remained *nomina nuda* until they were described in part by Hooker in *Species Filicum* (1844–1866), and in part by Presl in his *Hymenophyllaceae* (1843) and in his *Epimeliae Botanicae* (1849) and other works. The types of these species are therefore divided between the Royal Herbarium at Kew and the herbarium of the Deutsches Botanisches Institut at Prague. The most complete series of Cuming's collections is at Kew, but extensive duplicate series exist in other herbaria. The types of Haenke's collections are at Prague, where Presl's rich fern collection exists, unmounted, just as its

* Smith, John. Enumeratio Filicum Philippinarum. Jour. Bot. 3 : 392–422. 1841.

founder left it. A few ferns were collected by Vidal and included in his *Revisión* (1886), and his *Catálogo* (1892) both printed at Manila, but these works contained no additions to the fern flora and their determinations are to say the least of doubtful value.

More important were the collections of Professor J. B. Steere, of Michigan University, who visited the islands between 1870 and 1875. The ferns of the Steere collection were worked over at Kew by M. W. Harrington,* who described a few species as new and made numerous additions to the known flora. The originals of the Steere collection are at Michigan University and a fair series of duplicates is at Kew.

A still more important collection of Philippine ferns was made in the years 1890–97 by A. Loher, a Bavarian traveler, which was almost as extensive as the earlier one of Cuming. Dr. H. Christ,† of Basel, studied Loher's collection, and his enumeration comprises 271 species, including many additions to the known flora and a number of new species.

Finally Herr O. Warburg, who has for years made a special study of the flora of the monsoon region, traveled in Luzon and the southern portion of Mindanao and made extensive collections. His ferns were studied by Dr. Christ and are listed in the first volume of *Monsunia*,‡ where Dr. Warburg has also given an exended revision of the species of *Selaginella* of the entire Indo-Pacific region from Japan to Australia. Many species were thus added to the Philippine flora, including quite a number of new species, especially in *Selaginella*.

The fern flora of the Philippines as known to-day embraces over 600 species, and it may be said that collection has only commenced. It is probable that when the area is fully explored the extensive archipelago so lately come into our possession will yield at least half as many more species. In order to furnish our botanical residents and travelers in the Philippines a means of un-

* Harrington, M. W. The Tropical Ferns collected by Professor Steere in the years 1870–75. Jour. Linn. Soc. **16**: 25–37. 1877.

† Christ, H. Filices Insularum Philippinarum. Bull. Herb. Boiss. **6**: 127–154, 189–211. *pl. 2–4.* 1898.

‡ Warburg, O. Monsunia, Vol. 1, 1900. Filicinae, by H. Christ, pp. 54–94. *pl. 2;* Rhizocarpaceae, Equisetaceae, Lycopodiaceae and Selaginellaceae, by O. Warburg, pp. 95–136. *pl. 3, 4.*

derstanding the relations of the fern flora of these islands, at least generically, we have prepared the following synopses of the genera known to exist in the islands, which include many forms widely different either from our own temperate ferns, or even from the ferns of the American tropics. The generic sequence here adopted will be found to differ widely from the treatment given in Hooker and Baker's *Synopsis Filicum* (1874), which unfortunately remains the only hand manual of the ferns of all lands and whose treatment of genera is as irrational as its recognition of specific distinctions is defective, generalized and indefinite. The system here adopted will accord more nearly with the treatment by Dr. Diels in *Die natürlichen Pflanzenfamilien*, which in the main is admirable, suffering lapses to the older system mainly in its treatment of the Cyatheaceae and the genera included under *Polypodium* and *Nephrodium*. In the Hymenophyllaceae we have followed in part the admirable treatment of Presl * which, in the main, was taken up by Van den Bosch, the only other monographer who has made a special study of the group, and which has been as systematically neglected by Hooker and Baker and by Sadebeck, who prepared this family for *Die natürlichen Pflanzenfamilien*. For convenience, references are here made to the *Synopsis Filicum* and *Die natürlichen Pflanzenfamilien*, where the treatment differs from either of the works named.

While the fern flora of the Philippines is only partially known, it is probable that there will be very few additions to the genera as the result of further exploration. With the exception of the Isoetales — usually the last pteridophytes to be collected in any region — all the orders are represented in the Philippine flora and among the Filicales all the families except the rare and unique Matoniaceae; from the known distribution of the two diverse species of this family it is not improbable that it will ultimately find a representative in our domain. Since the present synopsis is intended chiefly to aid in distinguishing generically the ferns that may be collected in the islands, suggestions are given here and there relative to special points to be noted in the field, since in many genera certain portions of the plant show more important

* Presl, C. B. Hymenophyllaceae. Eine botanische Abhandlung. 1–70. *pl.* 1–12. Prag, 1843.

diagnostic characters than others and need to be specially noted in the field, particularly in plants too large to be collected entire. A few general features should always be noted and these are here summarized:

1. In all ferns not over two feet high an entire plant should be secured, but in plants growing in dense crowns the rootstock may well be split lengthwise and several of the leaves removed before drying.

2. In all ferns not over four feet high an entire leaf should be secured if possible attached to the rootstock or to some portion of it. In case of very wide leaves the lower pinnae on one side may be cut away to prevent the too great massing of foliage when the leaf is doubled on itself to make a manageable specimen.

3. In tree-ferns the basal portion of the petiole should always be secured, if possible, attached to the lower pinnules. Where possible the top of the caudex should also be taken. Notes on the character of the leaf-scars should always be made.

4. If the specimen taken does not show whether the leaves are scattered or cespitose this fact should always be included in the notes.

5. In ferns of whatever size, invariably secure some portion of the rootstock, for it nearly always possesses diagnostic characters.

6. In large leaves note whether the lowermost pinnae are larger than the others or are reduced in size and if their laminae stand in the same plane as the rest of the leaf or are set obliquely.

Had the earlier collectors followed such directions instead of taking mere tips of large leaves, or single leaves of smaller ferns wholly without rootstocks, we would now be saved the uncertainty of identifying plants with descriptions based on such scrappy materials.

The six orders represented in the Philippines may be distinguished as follows:

1. Plants of fern-like habit, mostly with broad leaves. 2.

Plants of rush-like habit; foliage reduced to whorls of united scales forming sheaths at the joints of the stems; sporangia borne under peltate shields collected in a terminal cone V. **Equisetales.**

Plants of moss like habit, with 4–10-ranked scale-like or linear leaves, terrestrial or epiphytic; sporangia borne in the axils of ordinary or modified leaves. VI. **Lycopodiales.**

2. Homosporous (spores uniform); all terrestrial or epiphytic except *Ceratopteris*. 3.
Heterosporous (producing minute microspores and larger macrospores); aquatic, rooted or floating; sporangia borne in ovoid or spherical conceptacles (*sporocarps*). IV. **Salviniales.**

3. Sporangia on the under surface of the leaf, borne in boat-shaped or circular conceptacles (*synangia*); eusporangiate; vernation circinate. II. **Marattiales.**
Sporangia borne in sori directly on the veins or exceptionally in spikes or panicles. 4.

4. Vernation erect or inclined; eusporangiate, the sporangia ringless, leathery, opening by a transverse slit, arranged in spikes or panicles. I. **Ophioglossales.**
Vernation circinate; leptosporangiate, the sporangia membranous, usually provided with a ring which opens elastically. III. **Filicales.**

I. OPHIOGLOSSALES

The fleshy plants of this order making up the single family Ophioglossaceae are arranged in four genera.

1. Terrestrial plants. 2.
Epiphytic, pendent from trees; leaf strap-like, bearing a spike near the middle. OPHIODERMA.

2. Sporangia in two-ranked spikes; leaves simple; veins anastomosing. OPHIOGLOSSUM.
Sporangia in panicles; leaves compound; veins free. 3.

3. Panicles lax, the sporangia 2-ranked. BOTRYCHIUM.
Panicles close, spike-like; the sporangia clustered and crested. HELMINTHOSTACHYS.

The members of this family are mostly small plants and the species of *Ophioglossum* especially would be likely to be overlooked. Four species of *Ophioglossum* are already known and the other genera are each represented in the islands by a single species. *Ophioderma* has leaves a yard or more long; it is often united to *Ophioglossum*, but in both habit and structure it is abundantly distinct.

II. MARATTIALES

The members of the tropical family Marattiaceae are mostly large fleshy plants with stout stems rising from ponderous corm-like trunks. There are three genera known from the Philippines:

1. Leaves ternate or palmate; synangia circular, depressed in the center. KAULFUSSIA.
Leaves pinnately compound; synangia oval or boat-shaped. 2.

2. Capsules concrete in boat-shaped synangia. MARATTIA.
Capsules close but not concrete, collected in oval sori. ANGIOPTERIS.

Kaulfussia is represented by a single small species with leaves resembling those of the horse-chestnut. *Marattia* has two with

bipinnate or tripinnate leaves eight to fifteen feet long, while *Angiopteris* has four nominal species * nearly as large.

III. FILICALES

The ferns proper with circinate vernation belonging to the leptosporangiate series are represented in the Philippines by several families distinguished as follows:

1. Sporangia opening longitudinally, paniculate (or in *Lygodium* borne singly and covered by scales on narrow projections from the leaves). 2.

   Sporangia sessile, borne on a special marginal thread-like receptacle, surrounded by a cup-shaped or bivalved involucre; texture translucent. 7. HYMENOPHYLLACEAE.

   Sporangia dorsal or marginal, attached directly to the lamina, usually collected in definite sori. 3.

2. Sporangia nearly globose with a rudimentary ring. 1. OSMUNDACEAE.

   Sporangia pyriform with an apical ring. 3. SCHIZAEACEAE.

3. Aquatic; leaves dimorphous; sporangial ring broad or rudimentary. 2. CERATOPTERIDACEAE.

   Terrestrial or epiphytic; sporangial ring complete, vertical. 4.

4. Sporangia sessile, wedge-shaped, radially arranged; stems simple or (in all Philippine species) pseudo-dichotomous. 4. GLEICHENIACEAE.

   Sporangia sessile or short-stalked in rounded sori; usually arborescent. 5. CYATHEACEAE.

   Sporangia usually long-stalked; herbaceous, rarely with an arborescent caudex. 6. POLYPODIACEAE.

To the above families belong the largest number of the ferns not only of the Philippines but of the entire world. While the greater part of the Philippine ferns bear a general resemblance to those of temperate regions there are many curious forms particularly among the epiphytic species that are quite unique and widely different from our ordinary conception of a fern. The two families Gleicheniaceae and the tree-ferns (Cyatheaceae) are not represented in temperate America at all, and the filmies (Hymenophyllaceae), rare with us, are abundantly represented in the Philippines as in all tropical regions.

FAMILY 1. OSMUNDACEAE

This family is represented in the Philippines by a single species of *Osmunda*, though it is quite possible that others may be found.

* Synopsis Filicum reduces all the forms of *Angiopteris* to a single species, but Presl defined ten, and DeVries and Harting who monographed the family in 1853 recognized sixty! From the fleshy nature of the plants it is a genus that requires field study, and description or even identification from herbarium material is necessarily defective.

FAMILY 2. CERATOPTERIDACEAE

The aquatic *Ceratopteris*, apparently a tropical cosmopolite, is the only known representative of this family.

FAMILY 3. SCHIZAEACEAE

Four genera of this family have been found in the archipelago; they may be distinguished as follows:

1. Sporangia solitary, covered by scales, arranged on marginal teeth of the leaves; leaves pinnate; stems twining. LYGODIUM.
   Sporangia in distichous spikes; plants small, erect. 2.
2. Leaves narrow, simple, grass-like. 3.
   Leaves broader, flabellately forked. LOPHIDIUM.
3. Spikes in a penicillate tuft. ACTINOSTACHYS.
   Spikes in a pinnate cluster. SCHIZAEA.

The last three genera, which have usually been united under *Schizaea*,* are inconspicuous plants represented in the Philippines by one species each. *Lygodium* is represented by six species which are conspicuous climbing ferns very unlike their single diminutive representative in our Eastern States.

FAMILY 4. GLEICHENIACEAE

This family is well represented in the Philippines by eleven species of *Dicranopteris*;† while this number is nominal it is likely not to be excessive, judging from the diversity of species in other tropical regions. The species are wide-spreading, often forming tangled thickets, and are easily recognized by the pseudo-dichotomous branching. They are very difficult to prepare for the herbarium and the greatest care should be taken to secure representative material, since the apical portions of a branch may be quite unlike the lower part of the same plant. By all means the lowest forking should be included in the specimen.

---

* In case the members of this alliance are grouped as a single genus it must bear the name *Lophidium*, the oldest available name for a member of this group. The three genera, however, are very homogeneous groups and may best be treated as above.

† The § *Mertensia* of Synopsis Filicum has been thought by many, commencing with Willdenow, to be worthy of generic rank, and has often been kept distinct from the typical Australasian species of *Gleichenia*. The name *Mertensia*, however, is not available since there is an earlier *Mertensia* in the Borraginaceae. *Dicranopteris* Bernh. is available for this group and was proposed for what has usually been known as *Gleichenia dichotoma* (*Polypodium dichotomum* Thunb.). *Mecosorus* Hassk. was a later name proposed by its author because of the preoccupation of *Mertensia*.

FAMILY 5. CYATHEACEAE

The tree-ferns of the Philippines do not appear to have been adequately collected, but the same is true of the family everywhere. They are not a suitable subject for ordinary herbarium study and should be specially prepared as already noted above. The characteristic armature or vestiture of the leafstalks should always be secured and if possible a section of the caudex. The genera represented in the Philippines are as follows:

1.	Sori marginal; indusium coriaceous, 2-valved; herbaceous species.	CIBOTIUM.
	Sori dorsal; tree-ferns.	2.
2.	Indusium inferior, cup-shaped.	CYATHEA.
	Indusium inferior, half cup-shaped.	HEMITELIA.
	Indusium wanting.	ALSOPHILA.

Cibotium is represented by *C. Barometz*,* often cultivated in American conservatories, and is not a tree-fern. The other genera form the genuine tree-ferns and include thirteen known species, four in *Cyathea*, eight in *Alsophila* and a single *Hemitelia*.

FAMILY 6. POLYPODIACEAE

The true ferns are the most abundant of any family and form three fourths of the fern flora of the islands, which is their usual proportion. The number of genera is so large that we can best distinguish them in their tribal relations separately:

1.	Sporangia scattered over the under surface of the leaf-blade in a uniform layer.†	2.
	Sporangia dorsal or marginal, accumulated in definite sori.	3.
2.	Leaves of two sorts; a shield-like basal leaf attached to the surface of the substratum and a furcate spreading one with localized sporangial surfaces.	1. *Alcicornieae.*‡
	Leaves approximately uniform; sporangia covering entire leaves or pinnae.	2. *Acrosticheae.*
3.	Sori marginal, continuous or interrupted, covered by a more or less modified portion of the leaf-margin. ‡	3. *Pterideae.*
	Sori dorsal, or at most submarginal, with or without indusia.	4.

* Included under *Dicksonia* in *Synopsis Filicum*.

† Certain Dryopterideae with confluent sori may be sought here. *Cf. Polybotrya*, *Anapausia*, *Egenolfia*, etc. Their habit is distinctively aspidioid, and lacks the jointed leaf-stalks of the Acrosticheae.

‡ We propose this tribal name for the "stag-horn ferns," believing their unique habit should separate them from the Acrosticheae with which they have usually been associated. The name comes from *Alcicornium* Gaud. (1826), which is an older name than *Platycerium*.

‡ The indusium is wanting in *Notholaena*.

4. Sori elongate-linear. 5.
Sori round or oval. 7.

5. Sori sunken in grooves. 3. *Vittarieae.*
Sori superficial. 6.

6. Indusium normally present (wanting in *Coniogramme* and *Hemionitis*). 6. *Asplenieae.*
Indusium wanting. Certain anomalous *Polypodieae.*

7. Leaves and primary venation fan-shaped; secondary venation anastomosing; indusium wanting. 7. *Dipterideae.**
Leaves and venation normally pinnate. 8.

8. Indusium superior or wanting. 9.
Indusium inferior, rupturing above the sorus. 10. *Woodsieae.*
Indusium attached internally, opening toward the leaf-margin (wanting in *Monachosorum*). 11. *Davallieae.*

9. Leafstalks jointed at their attachment with the rootstock, leaving definite scars when they separate. 10.
Leafstalks continuous with the rootstock; sori dorsal or terminal on the veins, normally indusiate. 8. *Dryopterideae.*†

10. Indusium wanting; sori dorsal or terminal. 4. *Polypodieae.*
Indusium present; sori near the base of the veins. 9. *Oleandreae.*

Tribe 1. Alcicornieae

This tribe is represented in the islands by two species of stag-horn fern (*Alcicornium*), characterized by the cordate basal sterile leaves, and the single species of *Cheiropleuria*, with linear sporophyls and two-lobed foliage. Both are epiphytic ferns.

Tribe 2. Acrosticheae

About five species of *Elaphoglossum* with simple free-veined leaves, and a single species of *Acrostichum* with pinnate leaves and anastomosing veins make up the known representation of this tribe in the Philippines. The dense masses of sporangia spread in a uniform layer over the leaves form a character easily recognized.

---

* *Dipteris* in *Synopsis Filicum* was placed in the genus *Polypodium*, with which it has no near alliance, and in *Die natürlichen Pflanzenfamilien* it is placed in the Aspidieae, in which it finds an equally insecure resting place. It is a unique fern without near relations and we place it in a distinct tribe.

† Since *Aspidium* as a generic name must be retired to the oblivion of synonymy, it is desirable that we have a tribal name which is derived from a typical or characteristic genus contained in it. We therefore substitute *Dryopterideae* for *Aspidieae* heretofore in use.

Tribe 3. Vittarieae

The three Philippine genera of this tribe may be characterized as follows:

1. Leaves narrow, grass-like; sporangia in one or more continuous lines. 2.
   Leaves broader; sporangia in broken lines often following the anastomosing of the veins. ANTROPHYUM.
2. Sporangial line medial, single. MONOGRAMMA.
   Sporangial lines double, marginal or submarginal. VITTARIA.

Eight nominal species of *Antrophyum*, six of *Vittaria* and one *Monogramma* have been reported from the Philippines. All are epiphytic in habit.

Tribe 4. Polypodieae

Two distinct series are represented in this tribe which normally includes the species lacking an indusium. In one series the sori are linear, in the other they are normally round ranging to oval. The genera may be distinguished as follows:

1. Sori linear, parallel to the midrib or margin. 2.
   Sori linear, oblique to the midrib; veins anastomosing. SELLIGUEA.
   Sori round or oval. 5.
2. Leaves simple. 3.
   Leaves pinnate. 4.
3. Leaves dimorphous, the sporophyls narrow. DRYMOGLOSSUM.
   Leaves uniform, the apex contracted and bearing the sporangia. BELVISIA.*
4. Sori median, between midrib and margin. TAENITIS.
   Sori finally covering the entire under surface. PLATYTAENIA.
5. Under surface of leaf densely covered with stellate hairs. CYCLOPHORUS.†
   Under surface smooth or barely scaly. 6.
6. Veins free. POLYPODIUM.
   Veins anastomosing. 7.
7. Basal leaves unlike the sporophyls, forming a nest-like cluster at the base of the plant. DRYNARIA.
   Leaves normally uniform. 8.
8. Sori dorsal, confined to the veins. 10.
   Sori dorsal, extending to the parenchyma. 9.
   Sori terminal on the veins and marginal on the leaf; sporophyls contracted; root-stocks much swollen. LECANOPTERIS.
9. Leaves pinnate. PHOTINOPTERIS.
   Leaves pinnatifid with decurrent segments. DRYOSTACHYUM.

---

* *Belvisia* Mirbel, antedates *Hymenolepis* Kaulf. adopted in *Die natürlichen Pflanzenfamilien* for this genus.

† *Cyclophorus* Desv. was perfectly well characterized and typified, and there is no excuse for using the later *Niphobolus* Kaulf.

10. Areolae regular, with a single free included veinlet which is directed outward. GONIOPHLEBIUM.*

Areolae small, irregular, with free veinlets spreading in various directions. PHYMATODES.*

Selliguea, joined with *Gymnogramme* in *Synopsis Filicum*, and united with *Polypodium* in *Die natürlichen Pflanzenfamilien*, is represented by eight species. *Drymoglossum*, *Dryostachyum*, *Taenitis* and *Platytaenia* have each a single representative in the Philippine flora, the last two in fact being monotypic genera.

Belvisia, included under *Acrostichum* in *Synopsis Filicum*, has two representatives. The remaining genera recognized above form a part of the unnatural genus *Polypodium*, as recognized in *Synopsis Filicum*. *Lecanopteris* and *Photinopteris* are represented each by a single species; *Cyclophorus* has sixteen nominal species, though not all reported have been taken up by Giesenhagen in his admirable monograph of the genus. This, however, is not an exhaustive treatment from a strictly taxonomic standpoint, containing some new things not properly correlated with that which is old. *Drynaria* similarly has ten nominal species, but the genus has never had a careful revision and all the species require very careful study afield. *Goniophlebium* has four species including the peculiar simple-leaved *Polypodium nummularium* on which Presl based his genus *Cryptosinus* perhaps with good reason. *Polypodium* and *Phymatodes* have the largest representation in the islands, the former with nineteen nominal species and the latter with thirty-eight. It is probable that both these genera will receive extensive additions, particularly among the smaller epiphytic species that from their habitat longer evade detection. Such at least has been the experience in other tropical regions. Taken as a whole this tribe is one of the largest as well as one of the most characteristic groups of the Philippine fern flora.

Tribe 5. Pterideae

Maidenhair ferns are apparently less common in the Philippines than in most tropical regions and the entire tribe to which they belong with the exception of a single genus has a comparatively

* The above synopsis follows exactly the lines noted in *Die natürlichen Pflanzenfamilien*, except that *Goniophlebium* and *Phymatodes* are there included under *Polypodium*, where in our judgment less attention has been given to venation than elsewhere in the work.

slight representation in the island flora. The several genera may be distinguished as follows:

1.	Sporangia attached to the under surface of marginal lobes; leafstalks black and shining.	ADIANTUM.
	Sporangia rising from a marginal vein-like receptacle.	2.
	Sporangia rising from the ends of unconnected veins; sori continuous or interrupted.	5.
2.	Indusium double, the inner membranous, extrorse.	3.
	Indusium single.	4.
3.	Leafstalks with several fibrovascular bundles.	PTERIDIUM.
	Leafstalks with a single semicircular fibrovascular bundle.	PAESIA.
4.	Spores sphaero-tetrahedral.	PTERIS.*
	Spores bilateral; leaves glaucous with auricled pinnae.	HISTIOPTERIS.
5.	Leaves uniform.	6.
	Leaves dimorphous.	8.
6.	Indusium continuous; stems black, polished.	DORYOPTERIS.
	Indusium interrupted.	7.
	Indusium wanting.	NOTHOLAENA.
7.	Sori distant in sinuses of leaf.	HYPOLEPIS.
	Sori crowded, more or less confluent.	CHEILANTHES.
8.	Leaves simply pinnate.	PLAGIOGYRIA.
	Leaves decompound.	ONYCHIUM.†

Of the above genera *Paesia* and *Histiopteris* are each represented by a single Philippine species, *Onychium*, *Pteridium*, *Doryopteris*, *Hypolepis*, and *Notholaena* by two each, and *Cheilanthes* and *Plagiogyria* by three each. *Adiantum* has six representatives, of which one and possibly two are introduced species, while over twenty species of *Pteris* have been reported. The latter genus, and particularly its larger species, require careful field study; the peculiar tripartite branching of the larger species should be specially noted.

Tribe 6. Asplenieae

Next to the Polypodieae this tribe forms the most extensive portion of the Philippine fern flora; the thirteen genera represented may be distinguished as follows:

1.	Sori parallel to the midribs.	2.
	Sori oblique to the midribs.	5.

* We have taken up *Pteris* as treated by Diels, *l. c.*, including species with both free and anastomosing veins. These have been separated by Presl and others, and further study will doubtless prove that they were correct.

† Diels following Prantl unites this with *Cryptogramma*, for which we can see no valid reason.

2. Indusium wanting; plants climbing; leaves dimorphous. STENOCHLAENA.
Indusium present; plants mostly terrestrial. 3.

3. Leaves uniform. 4.
Leaves dimorphous; sori intramarginal; caudex sometimes arborescent. STEGANIA.*

4. Veins anastomosing between the sori and the margin. WOODWARDIA.
Veins free between the sori and the margin. BLECHNUM.

5. Indusium wanting. 6.
Indusium present. 8.

6. Veins free. 7.
Veins anastomosing. HEMIONITIS.†

7. Sori forked, with the forking of the veins. CONIOGRAMME.‡
Sori simple, linear. SYNGRAMMA.‡

8. Veins free. 9.
Veins anastomosing. 10.

9. Sori confined to one side of a vein, linear or slightly curved. ASPLENIUM.§
Sori curved or horseshoe-shaped, crossing to both sides of the veins. ATHYRIUM.§
Sori double, the indusia opening on both sides of some of the veins. DIPLAZIUM.
Sori rising from a special receptacle midway between veins; indusia attached to the veins, opening toward each other. TRIPHLEBIA.

10. Veins connected only at their apices; leaves simple, densely clustered. THAMNOPTERIS.‖
Veins forming regular areolae. CALLIPTERIS.¶

Woodwardia, *Hemionitis* and *Coniogramme* are each represented in the Philippines by a single species, *Triphlebia* and *Syn-*

* Diels unites this with *Blechnum*, although under the name *Lomaria* the genus is held as distinct even in *Synopsis Filicum*. The name *Struthiopteris* must hold for the European and North American representative of the genus (*S. Spicant*) and *Lomaria* had for its type a member of another genus, so must be replaced by *Stegania* R. Br., if generic distinctness from the North Temperate representatives is maintained.

† *Hemionitis* is associated in *Die natürlichen Pflanzenfamilien* with the Pterideae, with which it appears to have no near relationship; it must either form a tribe by itself or be associated here with its nearest but not very close allies.

‡ *Coniogramme* and *Syngramma* form a part of the heterogeneous *Gymnogramme* of *Synopsis Filicum*; Diels associated them with the Pterideae, for which we can see no warrant.

§ It is still an open question as to what we shall consider the generic types of these two genera; they are adopted here tentatively in their usually accepted sense.

‖ The "bird's nest fern"; united with *Asplenium* by both Diels and Baker.

¶ The earlier name for *Anisogonium* Presl. Diels unites it with the free-veined *Diplazium* and both are joined as sections of *Asplenium* in *Synopsis Filicum*. *Allantodia* of *Synopsis Filicum* is also reported from the Philippines, but the name cannot hold for the species to which it is assigned and the genus is not clearly distinguished from *Callipteris*.

gramma by two each, *Stenochlaena*, *Thamnopteris* and *Athyrium* by four each, *Stegania* by five, and *Blechnum* by six; the larger genera are *Callipteris* with twelve species, *Diplazium* with twenty-one, and *Asplenium* with thirty-three. These numbers, however, represent nominal species and yet are not likely to be much reduced, and will be varied only by future discoveries.

Tribe 7. Dipterideae

This tribe is represented only by a single species of the curious fan-shaped *Dipteris*, perhaps one of the most unique among the ferns of the islands. Its leaves are often two or three feet broad.

Tribe 8. Dryopterideae

Related to our wood-ferns are a large number of species in all tropical regions and the Philippines come in for their share. The sixteen genera are distinguished as follows:

1. Veins normally free, simple, forked, or pinnately branched. 2.
   Veins connivent, *i. e.*, the branches from contiguous pinnate groups uniting to form one or more arches. 4.
   Veins copiously anastomosing. 6.
2. Leaves dimorphous; sori extending from the veins to the parenchyma so as to appear continuous. 11.
   Leaves uniform or nearly so. 3.
3. Indusium wanting; margins of segments plane. PHEGOPTERIS.
   Indusium circular, peltate. 8.
   Indusium oval, attached by a central axis to a thickened linear receptacle. DIDYMOCHLAENA.
   Indusium cordate-reniform, attached by the sinus; veins distinct. DRYOPTERIS.
4. Indusium wanting. 5.
   Indusium cordato-reniform, attached by the sinus. CYCLOSORUS.
5. Sori round, punctiform. GONIOPTERIS.
   Sori elongate on the more or less parallel transverse arches. MENISCIUM.
6. Indusium wanting. 7.
   Indusium cordato-reniform, attached by the sinus. 9.
   Indusium orbicular, centrally peltate. 10.
7. Leaves dimorphous; sori extending to parenchyma so as to appear continuous. 12.
   Leaves uniform. ARCYPTERIS.*

* The genus *Dictyopteris* Presl (1836) is antedated by a genus of the same name among the algae. We therefore propose the name **Arcypteris,** with the same meaning. It is not the exact equivalent of *Dictyopteris* Presl, the first species of which was *Polypodium attenuatum* R. Br., which does not belong to the § *Dictyopteris* as taken up by *Synopsis Filicum*. *Aspidium difforme* Blume (Enum. Pl. Jav. 160. 1828) may be considered as the type of *Arcypteris*.

8. Pinnae continuous with the rachis; texture firm, more or less coriaceous. POLYSTICHUM.
   Pinnae articulated with the rachis, easily caducous; texture thin herbaceous. CYCLOPELTIS.
9. Areolae irregular, without free veinlets. PLEOCNEMIA.
   Areolae provided with free recurrent veinlets. SAGENIA.
10. Areolae regular; included veinlets straight, directed towards the margins of the segments. CYRTOMIUM.
    Areolae irregular, fine; included veinlets often branched and recurrent. TECTARIA.
11. Rootstock short. EGENOLFIA.
    Rootstock widely climbing. POLYBOTRYA.
12. Areolae few, without free included veinlets. STENOSEMIA.
    Areolae copious, with free included veinlets. ANAPAUSIA.*

The disposition of these genera by Hooker and Baker and by Diels is so diverse that it can be best represented in tabular form:

Genera here accepted	Number of Philippine species reported	Equivalent genera in *Die natürlichen Pflanzenfamilien*	Equivalent genera in *Synopsis Filicum*
Phegopteris	9	Nephrodium	Polypodium
Polystichum	9	Polystichum	Aspidium
Cyclopeltis	1	Cyclopeltis	Aspidium
Didymochlaena	1	Didymochlaena	Didymochlaena
Dryopteris	44	Nephrodium	Nephrodium
Cyclosorus	24	Nephrodium	Nephrodium
Goniopteris	6	Nephrodium	Polypodium
Meniscium	2	Nephrodium	Meniscium
Arcypteris	5	Nephrodium	Nephrodium
Pleocnemia	5	Nephrodium	Nephrodium
Sagenia	9	Aspidium	Nephrodium
Cyrtomium	1	Polystichum	Aspidium
Tectaria	7	Aspidium	Aspidium
Egenolfia	1	Polybotrya	Acrostichum
Polybotrya	5	Polybotrya	Acrostichum
Stenosemia	1	Stenosemia	Acrostichum
Anapausia	12	Gymnopteris	Acrostichum

Tribe 9. Oleandreae

This tribe is represented in the Philippines by four nominal species of *Oleandra*, the only genus in the tribe. Their satiny luster renders them peculiarly attractive among ferns.

Tribe 10. Woodsieae

This tribe is represented in our eastern possessions only by one species of *Diacalpe*.

* These have been usually placed in *Gymnopteris*, but that genus was monotypic as originally founded and based on a plant of a wholly different alliance.

Tribe 11. Davallicae

The eight genera represented may be distinguished as follows:

1. Pinnae one-sided: indusium double, the inner membranous, the outer formed of the more or less changed leaf-margin. LINDSAEA.
   Pinnae developed on both sides of midrib, though not always equally. 2.

2. Indusium attached only at base. 3.
   Indusium attached on three sides. 4.
   Indusium wanting; sori subterminal on the veins. MONACHOSORUM.

3. Pinnae jointed to the rachis. NEPHROLEPIS.
   Pinnae not jointed; leaves jointed to the rootstock. HUMATA.
   Pinnae not jointed; leaves not jointed to the rootstock. SACCOLOMA.

4. Leaves jointed to the rootstock. DAVALLIA.
   Leaves not jointed to the rootstock. 5.

5. Leaf-lobes as long as indusium and both uniting in a special cup beneath the sorus. DENNSTAEDTIA.
   Leaf-lobes slightly modified, longer than the indusium. 6.

6. Sorus with a receptacle containing tracheids; leaves scattered on a creeping rootstock. MICROLEPIA.
   Sorus without a tracheidal receptacle; leaves clustered. ODONTOSORIA.

The Malaysian region is the home of certain groups of the davallioid ferns; *Humata* is represented by twelve species; *Davallia* also by twelve species, of which six belong to the § *Odontoloma*, sometimes recognized as a genus; *Odontosoria* by a single species, and *Microlepia* by nine; all the foregoing are included in the genus *Davallia* in *Synopsis Filicum*. Of the other genera *Nephrolepis* has eight nominal Philippine species, a number which may be modified, since the genus is sadly in need of a revision; *Lindsaea* has seventeen, *Dennstaedtia* has four, and *Monachosorum* and *Saccoloma* each one.

FAMILY 7. HYMENOPHYLLACEAE

Following the usual treatment the filmy ferns are grouped in two genera representing the primary divisions in the following synopsis. We believe, however, that many of the genera established by Presl are as clearly marked natural groups as can exist among the ferns, and in the following treatment we have taken up such of Presl's genera as occur in the Philippines, believing that others represented in tropical America and elsewhere represent equally natural groups.

The Philippine genera are as follows:

1. Indusium tubular; receptacle filiform exserted. (*Trichomanes* Syn. Fil.) 2.
   Indusium 2-valved, formed of two divided laminae of the leaf; receptacle shorter than the indusium or barely protruding. (*Hymenophyllum* Syn. Fil.) 6.

2. Margin of the indusium entire. 3.
   Margin of the indusium 2-lipped. 5.

3. Receptacle terminating in a rounded head. CEPHALOMANES.*
   Receptacle uniformly terete. 4.

4. Leaves and indusia bordered by rows of minute cells. ABRODICTYUM.†
   Leaves of uniform texture not bordered. TRICHOMANES.

5. Indusium contracted below the lips, bordered by the tissue of the leaf. DIDYMOGLOSSUM. ‡
   Indusium lateral, subpedicellate, not contracted nor bordered. MERINGIUM. §

6. Receptacle clavate; leaves smooth; sporangia sessile. HYMENOPHYLLUM.
   Receptacle globose-thickened at the summit; leaves often covered or margined with simple or stellate hairs, sometimes smooth; sporangia stipitate. SPHAEROCIONIUM. ‖

Of the above genera *Cephalomanes*, *Abrodictyum*, and *Meringium* are each represented by a single species, *Sphaerocionium* and *Didymoglossum* by six each; *Hymenophyllum* still has a residue of fourteen species, and *Trichomanes* a still larger one of twenty-four. There has been no modern monograph of this family, so that these numbers are likely to be varied greatly aside from future additions to the flora.

IV. SALVINIALES

Both families of this order are represented in the Philippines: the floating Salviniaceae by a single species of *Azolla*, and the rooting Marsileaceae by a single species of *Marsilea* with the usual

---

* *Cephalomanes* Presl, Hymenophyllaceae, 17. *pl. 5.* 1843. Monotypic; based on *C. atrovirens* Presl (Luzon, *Cuming, no. 169*); there was evidently a mixture in this number, for Hooker in commenting on Presl's genera says that his plant under that number is *Trichomanes Javanicum*. Presl later defends his genus in vigorous language and adds other species, and the genus was accepted by Van den Bosch.

† *Abrodictyum* Presl, Hymenophyllaceae, 20. *pl. 7.* 1843. Monotypic; based on *A. Cumingii* Presl (Luzon, *Cuming, nos. 208, 358*).

‡ *Didymoglossum* Desv. Ann. Soc. Linn. Paris, **6**: 330. 1827. Based on *Trichomanes muscoides* Sw. (first named) and seven other species.

§ *Meringium* Presl, Hymenophyllaceae, 21. *pl. 8, f. B.* 1843. Based on two species, of which *M. Meyenianum* Presl (Luzon, *Meyen*) is named as type.

‖ *Sphaerocionium* Presl, Hymenophyllaceae, 33. *pl. 4, f. B; pl. 10, f. B, C.* 1843. Based on *Hymenophyllum hirsutum* Sw. (first named) and numerous other species.

quadripartite foliage characteristic of the genus. The species of *Marsilea* grow in wet places and often resemble in habit small plants of *Oxalis*.

V. EQUISETALES

This order of a single family has at present one known representative in the Philippines, *Equisetum debilis*, also found in southeastern Asia.

VI. LYCOPODIALES

All three of the families of this order are represented in the Philippines. They may be easily recognized as follows:

1. Spores minute, of one sort. 2.
   Spores of two sorts, minute microspores and larger macrospores; leaves (in all Philippine species) 4-ranked, of two sizes. 3. SELAGINELLACEAE.
2. Sporangia unilocular. 1. LYCOPODIACEAE.
   Sporangia 2–3-locular. 2. PSILOTACEAE.

The Lycopodiaceae are represented by thirteen species of *Lycopodium*, two of which are said to be species of the temperate or subboreal region of the United States, a statement which appears scarcely credible.

The Psilotaceae are represented by *Psilotum nudum* with leaves reduced to mere rudiments, and trilocular sporangia, and *Tmesipteris Tannensis* with oval leaves nearly an inch long and bilocular sporangia. The Selaginellaceae are represented by thirty-three species of *Selaginella*, the larger part of which have been added through the labors of Dr. Warburg.

SUMMARY

Orders	*Families*	*Genera*	*Species*
Ophioglossales	1	4	7
Marattiales	1	3	7
Filicales	7	91	568
Salviniales	2	2	2
Equisetales	1	1	1
Lycopodiales	3	4	48
Totals	15	105	633

The fern flora of the Philippines is evidently related on the one hand to that of Formosa and the Asiatic continent, and on the other to that of the more southerly islands of Celebes and Borneo; the extensive recent additions to the fern flora of the

latter island through the discoveries of Bishop Hose open up a series of interesting distributional problems relative to the southern islands of the Philippine group which have never yet been explored botanically. It is hoped that some American residents in the Philippines will become interested in the ferns of the islands and make extended studies of their interesting pteridophyte flora. We shall be only too glad to render any assistance in specific identification that may be sought in the hope that our knowledge of the fern flora of this prolific region may be thereby extended.

COLUMBIA UNIVERSITY, 1 November, 1903.

Since the above article was in print I have learned of the publication of a paper by Mr. E. D. Merrill on the botanical work already accomplished in the Philippines, said also to give an account of the existing herbaria in the archipelago.—L. M. U.

INDEX TO THE GENERA OF PHILIPPINE FERNS

Abrodictyum, 681
Acrostichum, 673
Actinostachys, 671
Adiantum, 676
Alcicornium, 673
Alsophila, 672
Anapausia, 679
Angiopteris, 669
Antrophyum, 674
Arcypteris, 678
Asplenium, 677
Athyrium, 677
Azolla, 681
Belvisia, 674
Blechnum, 677
Botrychium, 669
Callipteris, 677
Cephalomanes, 681
Ceratopteris, 671
Cheilanthes, 676
Cheiropleuria, 673
Cibotium, 672
Coniogramme, 677
Cyathea, 672
Cyclopeltis, 679
Cyclophorus, 674
Cyclosorus, 678
Cyrtomium, 679
Davallia, 680
Dennstaedtia, 680
Diacalpe, 679
Dicranopteris, 671
Didymochlaena, 678
Didymoglossum, 681
Diplazium, 677
Dipteris, 678
Doryopteris, 676
Drymoglossum, 674
Drynaria, 674
Dryopteris, 678
Dryostachyum, 674
Egenolfia, 679
Elaphoglossum, 673
Equisetum, 682
Goniophlebium, 675
Goniopteris, 678
Helminthostachys, 669
Hemionitis, 677
Hemitelia, 672
Histiopteris, 676
Humata, 680
Hymenophyllum, 681
Hypolepis, 676
Kaulfussia, 669
Lecanopteris, 674
Lindsaea, 680
Lophidium, 671
Lycopodium, 682
Lygodium, 671
Marattia, 669
Marsilea, 681
Meniscium, 678
Meringium, 681
Microlepia, 680
Monachosorum, 680
Monogramma, 674
Nephrolepis, 680
Notholaena, 676
Odontosoria, 680
Oleandra, 679
Onychium, 676
Ophioderma, 669
Ophioglossum, 669
Osmunda, 670
Paesia, 676
Phegopteris, 678
Photinopteris, 674
Phymatodes, 675
Plagiogyria, 676
Platytaenia, 674
Pleocnemia, 679
Polybotrya, 679
Polypodium, 674
Polystichum, 679
Psilotum, 682
Pteridium, 676
Pteris, 676
Saccoloma, 680
Sagenia, 679
Schizaea, 671
Selaginella, 682
Selliguea, 674
Sphaerocionium, 681
Stegania, 677
Stenochlaena, 677
Stenosemia, 679
Syngramma, 677
Taenitis, 674
Tectaria, 679
Thamnopteris, 677
Tmesipteris, 682
Trichomanes, 681
Triphlebia, 677
Vittaria, 674
Woodwardia, 677

Anatomy and Physiology of Baccharis genistelloides

By Elsie M. Kupfer

Baccharis genistelloides Pers. is an inhabitant of the mountains of Peru, growing in dry places at an altitude of about 1200 meters. It has several well-marked varieties which apparently spread north into Ecuador, and south and east into Brazil. The typical form is a slightly shrubby plant of extremely peculiar appearance. The leaves are atrophied, being represented by minute scales scarcely more than 2 mm. in length; and the work of photosynthesis is assumed by conspicuous wings which stand at three equal angles from each other. The scales are arranged in three orthostichies, and two wings originate from the base of each scale. One of these wings runs through only one internode and terminates at the margin of the scale below; the other, in each case, runs through two internodes until it is similarly stopped. This alternation of a long and a short wing in each orthostichy, as well as the fact that the wings (following the phyllotaxy) twist spirally, accounts for the curious appearance of the plant represented in *f. 1*.

While the shoot is almost uniformly leafless in the upper portion, usually one, two, or even several normal leaves are to be found near its base. They are of moderate size, obovate and somewhat thickened (*f. 2* and *3*). The genus *Baccharis* is a large, and as far as leaf-form is concerned, a heterogeneous one. The leaves of many species, *e. g.*, *B. floribunda* and *B. trinervis*, are large, thin and smooth; others, as those of *B. alpina* and *B. microphylla*, are minute and thickened; *B. aphylla* and *B. gracilis* have only narrow phyllodes; and, finally, *B. genistelloides* and *B. fastigiata* are devoid of foliar leaves. The leaves of several of the species, however (and it is significant that these are generally South American species), particularly *B. dioica* and *B. cassinaefolia*, closely resemble in shape, size and texture the juvenile leaves of *B. genistelloides*. There is every reason, then,

it seems to me, for considering this form as that of the ancestral type.

The seeds, unnamed, were brought from Peru by Mr. de Lautreppe in 1900 and planted

FIG. 2. Shoot from base of plant of *Baccharis genistelloides*, showing leaves.

in the New York Botanical Garden. Because of the ignorance as to their identity, little attention was given to the plants until they had attained a considerable size; so that unfortunately none of the early stages has been ob-

FIG. 3. Single leaf of *Baccharis genistelloides*, natural size.

served. At the present time, in the beginning of their third year, the plants are about 1 meter high. The stems near the base are secondarily thickened, and the wings there are either much thickened or have been entirely lost. Several of the plants flowered in February, 1902, and again in December, 1903; but although the flowers were pollinated, the seeds produced were exceedingly minute and failed to germinate.

FIG. 1. Shoot of *Baccharis genistelloides*.

Noteworthy adaptations to an environment both of strong light

and excessive dryness come to light on an examination of the anatomy and physiology of the plant.

THE EPIDERMAL SYSTEM

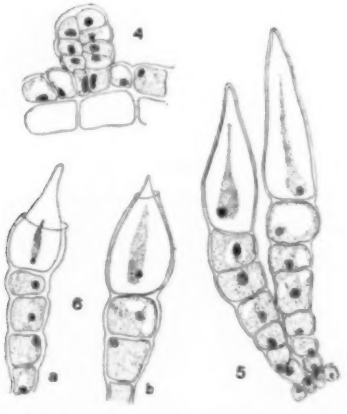
The protective system of the plant is very well developed. There is a considerable covering of wax over the whole plant (cf. *f.* 9). In addition, the epidermal cells are cuticularized both without and within; and particularly in the younger portions, the surface is covered with peculiar hairs, of which usually only the end-cells project above the wax. The stomata are exserted and are apparently sensitive. The *wax* is laid down in the form of irregular plates fitted together into a sort of mosaic. In the younger portions, to about 3–7 cm. back of the tip, the waxy covering is very thick, while the outer layers are shed in the form of powdery scales. Its very ready solubility in ether indicates its fatty nature. The *cutin* is present in a layer over the entire plant even up to the very tip of the growing point, though, naturally, it has less thickness here than in the older parts of the plant. The surfaces of the leaves present on the lower parts of the plant are more heavily cutinized than either the wings or the stem.

The *hairs* almost always arise in pairs from two adjacent epidermal cells. In most of the members of this family, as Vesque,* whose observations have been confirmed by more recent investigators, points out, two kinds of hairs are to be found: glandular hairs and mechanical hairs. Both kinds are present in this plant. The gland-hairs, which are composed of double series of from 3–5 cells each, differ from those mentioned by Vesque and Solereder † in that all but the end-cells contain chlorophyl. The cutin is but slightly raised by the not very abundant secretion, the nature of which has not been any more definitely determined than that it is odorless and soluble in ether (*f.* 4). That the secretion of wax is to be assigned to the epidermal cells in general, and not particularly to these hairs, seems probable from the fact that few or none of the hairs are to be found on the older portions of the plant, where, nevertheless, the wax is abundant.

* Vesque, T. Caractères des * * * Gamopétales. Ann. Sci. Nat. Bot. VII. 1: 183. 1885.

† Solereder, H. Systematische Anatomie der Dikotyledonen. 515 ff. 1899.

The whip-hairs, too, seem to differ from the types of Vesque in that they are also, as a rule, bicollateral. They are thus apparently homologous with the gland-hairs. The early condition of the two kinds of hairs is very similar, the only difference being that the whip-hairs are from the beginning devoid of chlorophyl. In the adult condition, however, they are entirely separated from each other. The enormously enlarged end-cells have walls so highly thickened that the cell-lumen is almost obliterated (*f.* 5). The developing whip-hairs are cutinized almost from the start. When fully formed they are also uniformly covered with cutin, but there is a stage in their growth in which the base only of the end-cells is surrounded by a collar of cutin, while the thickened



Hairs of *Baccharis genistelloides*. FIG. 4. Gland-hair. FIG. 5. Two whip-hairs. FIG. 6, *a*, *b*. Developing whip-hairs.

cellulose wall of the upper part shows prominently above and through it (*f.* 6 *a* and *b*). Probably the cell in its period of hypertrophy breaks through its cutin covering, which is reëstablished after growth has ceased. The two whip-hairs often fail to develop simultaneously, so that a pair is frequently found, one of which is still in its prime, while the other consists of only shriveled empty cells. As far as has been determined, new hairs of either kind are not developed much below 5–6 cm. from the tip. As some also drop entirely off, the hairs on the older portions are very scattered and frequently consist of only the shriveled cells.

It is difficult to determine the function of either kind of hairs, if they have any. In the younger parts, where alone the hairs are plentiful, they are often entirely embedded in the wax. The gland-cells are usually thickly covered, while occasionally part of the end-cell of the whip-hair protrudes beyond. Of what use can a secretion be, the escape of which is entirely prevented? In the cases among the Compositae in which the whip-hairs are found, they are usually present as Vesque shows as a tomentum. Probably here, as in *Chrysoma pauciflosculosa* described by Professor Lloyd, they are functionless.*

The *stomata* are evidently of a motile type (*f.* 7). They are provided with distinct accessory cells, so that this plant adds another to the list of composites so provided, although Benecke † declares these cases rare. Both upper and lower walls taper into very finely pointed ridges. No trace of a hinge has been discovered by me, but the cutin seems thinner at the junction of the guard and accessory cell. The accessory cells raise the stomata somewhat above the level of the epidermis. They are more exserted on the stem than on the wing.

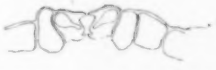


FIG. 7. Stoma from stem of *Baccharis genistelloides*.

THE STEM

In the plants examined, the stem varies in thickness from 1 to 4 mm. In the younger portions, to about 12 cm. from the tip, the supporting tissue consists largely of sclerenchyma, the wood proper being confined to a very narrow ring about 25 μ in diameter. The masses of bast-fibers are found at intervals around the stem, but the six largest masses are opposite the three wings and half way between them respectively (*f.* 8). These bast-fibers are strongly lignified, so that they give a much more pronounced reaction with phloroglucin than the young wood-ring itself. The lignification of the bast-fibers begins very near the growing tip; signs of it can be found at the distance of 1.5 cm. therefrom. This early acquisition of lignin would seem to indicate a very slow rate of growth — a point which will be recurred to presently.

* Lloyd, F. E. Anatomy of *Chrysoma pauciflosculosa*. Bull. Torrey Club, **28**: 445. Au 1901.

† Bot. Zeit. **50**: 570. 1892.

The bast-bundles lie so close to the circle of wood — a feature according to Solereder characteristic of the Compositae — that no cambium was distinguishable as such in any portion of the stem of the growing plants. There are a number of thin-walled irregular cells between wood and bast, most of which are sieve-tubes; but some must be of a meristematic nature, because the wood-cylinder gradually increases in diameter so as to be about 60 mm. at a

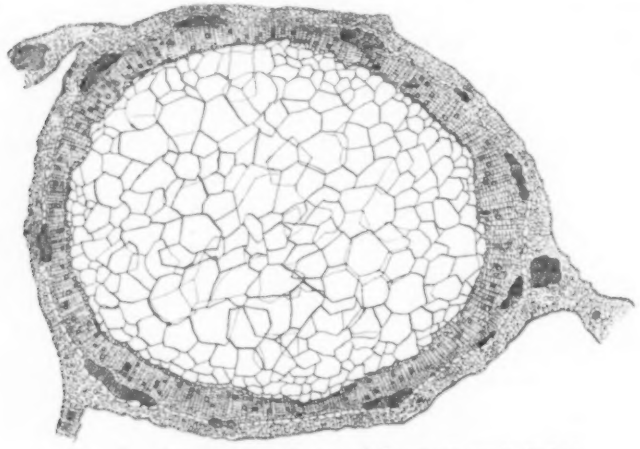


FIG. 8. Cross-section of stem of *Baccharis genistelloides*.

distance of 15 cm. from the tip, 125 mm. at 19 cm., and 166 mm. at the base of the plant examined.

In an older stem taken from a herbarium specimen there were present three definite wood-rings and a very clearly established cambium layer. The wood on maceration was found to contain spiral, pitted and annular vessels. Wood parenchyma is abundant, but the medullary rays are obliterated. Around the primary bast-masses when they occur, otherwise external to the sieve tissue, an endoderm of one layer of rather large clear cells extends. Outside of this lies the cortex, of three or more rows of chlorophyl-bearing cells. Outside of the bast-bundles, however, these cells lose their chlorophyl and become collenchymatic. The angles of the older stems from which the wings have been lost become heavily suberized.

APOGEOTROPISM

The stems of *Baccharis genistelloides* are markedly apogeotropic. A number of the branches of plants which have been grown in a moist greenhouse have fallen down from their own weight. In all cases, however, the tips have turned perpendicularly upwards, and the plants present a very striking appearance in consequence. They are markedly different from the diageotropic shoots of *B. halimifolia*, which is growing in the same place. That this falling down of the branch is also characteristic of the plant in its natural environment is seen from herbarium specimens. There are often as many as six upright branches from one prostrate one.

THE WING

The wings are the conspicuous portion of the plant; they vary in width from a few millimeters at the youngest portions to 2 cm. at the older. The length depends upon their relation to the internodes. As shown above (*f. 1*) some wings go through only one, others through two internodes, the longer ones being from 10–18 cm., the shorter from 3–8 cm. A transverse section (*f. 9*) shows a very compact structure. There is no definite palisade or spongy tissue. Several rows of chlorophyl-bearing cells packed more or less closely extend inward from both surfaces. The air spaces, which are comparatively few, are chiefly situated in the middle of the wing. The stomata are approximately equal in number on both sides of the wing, averaging 70–80 to the square millimeter.

The wings are notably rigid; this is due to the occurrence of strands of mechanical tissue which are developed in connection with the vascular bundles. The conducting tissue plays but an unimportant rôle in the support of the wing. There is a particularly large stereome mass on the extreme edge, which is readily removable as a thick thread.

In order to determine the morphology of the wing, serial sections of the growing point were prepared. From these it appeared that the wings are directly continuous with the margins of the scales. On comparison with shoots bearing true leaves this view was substantiated. In the terms of many of the text-books, then, these wings would stand as "decurrent leaves" — as elaborations

of the leaf-base, named by Vines the "hypopodium." Their peculiar phyllotactic arrangement would thus obviously be explained. The question was raised however as to whether these facts alone, *i. e.*, the connection with the leaf-base and their phyllotactic relation, would be sufficient to establish the homology with leaf-structures. The point was decided in the negative for the following reasons:

1. Their main axes, even at the growing point, are parallel to the stem, instead of at a greater or less angle as in other developed leaf-bases, *i. e.*, stipules.

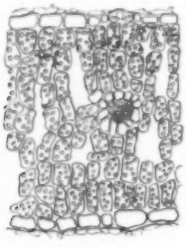


FIG. 9. Cross-section of wing of *Baccharis genistelloides*.

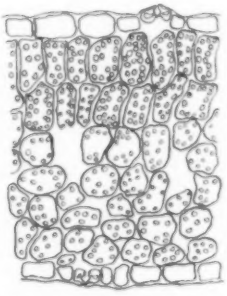


FIG. 10. Cross-section of leaf of *Baccharis genistelloides*.

2. In many plants, *Lathyrus latifolia*, *L. sylvestris* and *L. grandiflorus* among others, both stipules and wings occur. In such cases the wings, although just as obviously continuous with the wings of the petiole, evidently could not be hypopodia.

3. Other organs have been found that follow the leaf arrangement, but may not therefore be supposed to be leaf-structures — for example the thorns in some species of *Rubus* and *Smilax*, the ridges in the stems of *Urtica gracilis*, *Mentha crispa* and *Leptandra Virginica*.

For these reasons the wings are, it seems to me, rather to be regarded as lateral-vertical expansions of the stem than as "decurrent leaf-margins."

PHOTOTROPISM

To determine the action of the plant towards light a growing shoot was fastened in a dark chamber illuminated from one side only. After fourteen days there was found to be a decided photo-

tropic reaction. The stem had turned towards the light, the bending region extending to about 3 cm. from the tip. The two wings nearest the aperture had turned at right angles to each other and in the direction of the rays, the third wing had moved to a position just behind and parallel to one of the others. In this way only its very edge was illuminated. Although at first it seemed as if the wings must have played a positive part in the movement towards the light, probably a purely mechanical explanation is to be assigned for their position. By experiment it was found that these would be the positions assumed by any rigid objects — such as strips of cardboard — fastened to a bending axis, so that probably only the stem was directly concerned in the reaction.

THE LEAF

The leaves themselves vary in size. The largest found measured 2.2 × 1.3 cm., the smallest 5 × 3 mm. (*f. 3*). They appear, as above pointed out, at the basal portion, but also occasionally on new shoots, developing from buds on these regions. A transverse section of the leaf (*f. 10*) shows that here also we have a fairly compact mesophyl structure. The intercellular spaces are, as in the wings, comparatively small. In the leaf, however, sharply distinguishing it from the wings in structure, we find a noticeable dorsi-ventral differentiation; for not only has the leaf a definite palisade parenchyma of two layers of cells, but a difference is also to be observed in the number of stomata present on the two surfaces. There are 106 stomata to the square millimeter on the lower surface to 50 on the upper. It is to be noted as significant that the whole number of stomata per square millimeter would average almost exactly the same in the case of the wing and the leaf.

REVERSION TO THE JUVENILE LEAF-FORM

Several experiments were started with a view to inducing the re-formation on adult shoots of the juvenile leaf-form. Some of the growing shoots were kept in a moist chamber, others in a dry and still others in a dark chamber for several weeks, but no results were obtained. This may have been due to one or more of several causes. First, of course, these particular agents may not induce leaf-formation in this plant; or again the failure may have been

due to the fact that growing shoots (and therefore shoots very far from the usual basal region of leaf-production) were used; or finally, it may have been due to the fact that all the shoots which were experimented with formed flower-buds on being released, as it is believed that when a shoot has once laid down the primordium of a flower it is thereafter unchangeable.

FIG. 11. Cutting of *Baccharis genistelloides*, showing production of juvenile leaves.

To avoid the repetition of these conditions it was determined to defer the experiments until such a time as separate plants would be available for the different experiments. For this purpose, but also more particularly to determine the effect upon the leaf-reversion, a large number of cuttings were made, consisting, of course, of the youngest shoots, *i. e.*, those farthest from the juvenile character. The cuttings were difficult to root; less than half of those planted at three different times succeeded. At present, however, there are about 15 more or less healthy young plants.

On three of the cuttings which were planted earliest, reversion shoots of a remarkable character developed. The first one to be affected produced from buds two branches, on each of which appeared three reversion leaves, and on which the wings were reduced almost to a minimum. Also (and this seems extraordinary) the main shoot produced near its apex several smaller leaves. This is the plant represented in *f. 11*.

On the second plant a similar set of phenomena was observable. Three shoots bearing some of the largest leaves that have been found and the greatly reduced wings appeared, and at the same time the tip of the shoot continued to produce leaves as it grew.

On the third the main shoot withered; and one of the buds produced a branch on which the wings are apparently normal, but on which three small leaves have been found. Four other plants produced leaves on branches that retained their wings.

The apogeotropic habit of the secondary branches made another experiment possible. A plant on which the main branch had fallen from its own weight and on which there were a number of such upright shoots was layered — that is, had its main stem covered with earth. After allowing the branches to rest in this condition for some time, the connection of the vertical shoots with one another and with the main stem was severed. However, although all the shoots flourished and grew into separate plants, none produced the leaves.

To sum up briefly the most important points brought out in this investigation:

1. *Baccharis genistelloides* is a plant remarkably well adapted by the loss of leaves, by the position of the wings, and by the coverings of the cutin, wax and hairs, to withstand a high degree of both dryness and insolation.

2. The glandular hairs differ from the hairs previously described in the Compositae in the possession of chlorophyl, and the whip-hairs in being biserial.

3. The early acquisition of lignin in the bast of the stem, and of mechanical tissue in the wings, gives to the plant its characteristic rigidity, and at the same time necessitates a short period of elongation.

4. The leaves found in any given portion of the stem on the older parts of the plant resemble closely the leaves of other species of *Baccharis*.

5. The leaf differs from the wing in structure in showing marked dorsiventrality, which is absent in the latter.

6. While the wings are directly continuous with the margins of the scales and of the leaves when present, and while they follow the phyllotaxy, they are to be considered morphologically as lateral-vertical expansions of the stem and not as "decurrent leaves."

7. The shoots have been shown to be markedly apogeotropic and positively phototropic.

8. Cuttings of growing shoots were made, a number of which after rooting produced branches which bore reversionary leaves and greatly reduced wings; the apices of the old shoots also produced the leaves in two cases.

The thanks of the author are due to Dr. D. T. MacDougal, under whose direction the work was carried on, and to Prof. F. E. Lloyd, for many valuable suggestions.

NEW YORK BOTANICAL GARDEN.

Ames, O. A new Species of *Habenaria* from Cuba. Proc. Biol. Soc. Wash. **16**: 117, 118. *f. 1, 2.* 30 S 1903.

Atkinson, G. F. A new Species of *Geaster*. Bot. Gaz. **36**: 303–306. *f. 1, 2.* 15 O 1903.

G. leptospermus, native of North Carolina.

Bailey, W. W. Lianes. Plant World, **6**: 203–205. S 1903.

Barnhart, J. H. Duplicate Binomials. Torreya, **3**: 142, 143. 26 S 1903.

Barrett, O. W. Three Ecological Problems. Plant World, **6**: 213. S 1903.

Baum, H. E. The Breadfruit. Plant World, **6**: 197–202. *pl. 26, 27.* S 1903; II. Plant World, **6**: 225–231. *pl. 29.* O 1903.

Berry, E. W. *Liriodendron* Notes. Torreya, **3**: 129–132. *f. 1–4.* 26 S 1903.

Braunton, E. *Echinocactus cylindraceus.* Cal. Floricult. **1**[1]: 18. N 1901. [Illust.]

Braunton, E. *Opuntia ursina.* Cal. Floricult. **1**[2]: 16. D 1901. [Illust.]

Bray, W. L. The Tissues of Some of the Plants of the Sotol Region. Bull. Torrey Club, **30**: 621–633. *f. 1–10.* 4 N 1903.

Britton, B. M. A New England Station for *Buxbaumia indusiata* Bridel. Rhodora, **5**: 257, 258. 13 O 1903.

Britton, W. E. Vegetation of the North Haven Sand Plains. Bull. Torrey Club, **30**: 571–620. *pl. 23–28.* 4 N 1903.

Cockerell, T. D. A. Two Orchids from New Mexico. Torreya, **3**: 139–141. 26 S 1903.

Includes description of *Corallorhiza Grabhami* sp. nov.

Collins, F. S. Isaac Holden. Rhodora, **5**: 219, 220. 6 S 1903.

Collins, F. S. Notes on Algae, — VI. Rhodora, **5**: 231–234. 6 S 1903.

Cushman, J. A. Notes on New England Desmids, — I. Rhodora, **5**: 221–225. 6 S 1903; — II. Rhodora, **5**: 252–255. 13 O 1903.

Dahlstedt, H. Studien über süd- and central-amerikanische Peperomien. Sv. Vet.-Akad. Handl. **33**[2]: 1–218. *pl. 1–11.* 1900.

A monograph of the genus *Peperomia*. It includes 28 new species from South and Central America and the West Indies.

Dandridge, D. The Oaks of West Virginia. Garden, **60**: 148, 149. 31 Au 1901; 163, 164. 7 S 1901.

Dandridge, D. A Search for Wild Asters. Garden, **60**: 360, 361. 30 N 1901; 398. 14 D 1901.

Dandridge, D. Some Wild Violets of Virginia. Garden, **60**: 94. 10 Au 1901.

Dandridge, D. The Virginia Woods. Garden, **59**: 138, 139. 23 F 1901.

Davis, B. M. *Tilletia* in the Capsule of Bryophytes. Bot. Gaz. **36**: 306, 307. 15 O 1903.

Eames, E. H. The Dentarias of Connecticut. Rhodora, **5**: 213–219. 6 S 1903.
Includes description of *Dentaria anomala* sp. nov.

Earle, F. S. A Key to the North American Species of *Galera*. Torreya, **3**: 134–136. 26 S 1903.

Ellis, J. B. & Everhart, B. M. New Species of Fungi from Various Localities. Jour. Mycol. **9**: 164–168. 29 O 1903.

Ferguson, A. M. Crotons of the United States. Ann. Rep. Mo. Bot. Gard. **12**: 33–73. *pl. 4–31*. 16 F 1901.

Fernald, M. L. *Arabis Drummondii* and its Eastern Relatives. Rhodora, **5**: 225–231. 6 S 1903.

Fernald, M. L. A New *Kobresia* in the Aroostook Valley. Rhodora, **5**: 247–251. 13 O 1903.
Gives a description of *K. elachycarpa* sp. nov.

Fetherolf, J. M. The Forest of Texas. Forest Leaves, **9**: 27. Ap 1903.

Freeman, E. M. The Seed-fungus of *Lolium temulentum* L., the Darnel. Phil. Trans. Roy. Soc. Lond. **B. 196**: 1–27. *pl. 1–3*. 4 Au 1903.

Fries, R. E. Beiträge zur Kenntnis der süd-amerikanischen Anonaceen. Sv. Vet.-Akad. Handl. **34**[5]: 1–59. *pl. 1–7*. 1900.
Includes new species in *Mosenodendron* gen. nov., *Guatteria* (3), *Aberemoa* (3), *Unonopsis* gen. nov., *Xylopia* (3), *Anona* and *Rollinia* (3).

Greata, L. A. About Mushrooms. Cal. Floricult. **1**[4]: 5–7. F 1902. [Illust.]

Greata, L. A. A Little Philosophy and a Phase of Plant Life. Cal. Floricult. **1**[3]: 10. D 1901.

Greata, L. A. Some Common Surprises in Plant Families. Cal. Floricult. **1**[1]: 8, 9. N 1901.

Griggs, R. F. A Remarkable *Physalis*. Torreya, **3**: 138, 139. 26 S 1903.

P. minuta sp. nov., from Mexico.

Harrison, F. C. & Lochhead, W. Some Common Ontario Weeds. Ont. Agric. Coll. Bull. 128: 1–96. *f. 1–39, A, B, 1–37*. Au 1903.

Harshberger, J. W. The Forest at the Natural Bridge, Virginia. Forest Leaves, **9**: 42–44. Je 1903.

Harshberger, J. W. Forest Growth at Wildwood, N. J. Forest Leaves, **9**: 40. Je 1903.

Herbst, W. Fungal Flora of the Lehigh Valley, Pa. 1–229. Allentown, Pa., 1899. [Illust.]

Howe, M. A. A Note on the "Flowering" of the Lakes in the Adirondacks. Torreya, **3**: 150–154. 30 O 1903.

Howe, M. A. Report on a Trip to Porto Rico. Jour. N. Y. Bot. Gard. **4**: 171–176. *f. 18–21*. O 1903.

Hutchings, C. E. A Supplementary Catalogue of the Sturtevant Prelinnaean Library. Ann. Rep. Mo. Bot. Gard. **14**: 233–316. [O] 1903.

Juel, H. O. Vergleichende Untersuchungen über typische und parthenogenetische Fortpflanzung bei der Gattung *Antennaria*. Sv. Vet.-Akad. Handl. **33**^{5}: 1–59. *pl. 1–6* + *f. 1–5*. 1900.

Kellerman, I. The Accentuation of Mycological Compound Names. Jour. Mycol. **9**: 162–164. 29 O 1903.

Kellerman, W. A. Minor Mycological Notes, I. Jour. Mycol. **9**: 169, 170. *pl. 3* + *f. 3*. 29 O 1903.

Lyon, F. M. Two Megasporangia in *Selaginella*. Bot. Gaz. **36**: 308. *f. 1*. 15 O 1903.

Mackenzie, K. K. A New Genus of North American Umbelliferae. Torreya, **3**: 158, 159. 30 O 1903.

Pseudotaenia montana gen. et sp. nov., from West Virginia.

Miller, G. S. The Short-leaved Sundew in Virginia. Proc. Biol. Soc. Wash. **16**: 102. 25 Je 1903.

Morgan, A. P. Note on *Corticium leucothrix* B. & C. Jour. Mycol. **9**: 162. 29 O 1903.

Morgan, A. P. Some Western Specimens. Jour. Mycol. **9**: 161. 29 O 1903.

Murray, G. Notes on Atlantic Diatomaceae. Jour. Bot. **41**: 275–277. 1 Au 1903.

Appended is a description of a new species of *Nitzschia* from the Atlantic plankton and the West Indies.

Parish, S. B. The Candlewood Tree. Cal. Floricult. 1^4: 3, 4. F 1902. [Illust.]

Parish, S. B. Our Native Pentstemons. Cal. Floricult. 1^2: 5, 6. D 1901.

Parish, S. B. A Sketch of the Flora of Southern California. Bot. Gaz. **36**: 203–222. 15 S 1903; 259–279. 15 O 1903.

Pollard, C. L. A New Violet from Kentucky. Proc. Biol. Soc. Wash. **16**: 127. 30 S 1903.
Viola Priceana sp. nov.

Pollard, C. L. The Nodding *Pogonia* in the Vicinity of Washington. Proc. Biol. Soc. Wash. **16**: 127. 30 S 1903.

Purdy, C. *Lilium Kelloggii.* Garden, **59**: 331. 11 My 1901. [Illust.]
A new species, from California.

Rand, E. L. *Galinsoga* in Maine. Rhodora, **5**: 258. 13 O 1903.

Rehder, A. Synopsis of the Genus *Lonicera.* Ann. Rep. Mo. Bot. Gard. **14**: 27–232. *pl. 1–20.* 8 O 1903.
A few new North American varieties and forms; all the new species are from China.

Richards, H. M. An Improvised Horizontal Microscope. Torreya, **3**: 136–138. *f. 1.* 26 S 1903.

Robinson, B. L. Further Notes on the Twelfth Preliminary List of New England Plants. Rhodora, **5**: 235, 236. 6 S 1903.

Robinson, B. L. Insecticides Used at the Gray Herbarium. Rhodora, **5**: 237–247. 13 O 1903.

Robinson, C. B. The Distribution of *Fucus serratus* in America. Torreya, **3**: 132–134. 26 S 1903.

Rothrock, J. T. Black Haw. (*Viburnum prunifolium* L.) Forest Leaves, **8**: 56. Au 1901. [Illust.]

Rothrock, J. T. Crab Apple. (*Pyrus coronaria* L.) Forest Leaves, **8**: 104. F 1902. [Illust.]

Rothrock, J. T. Jersey Scrub Pine. Scrub Pine. (*Pinus inops* Ait.) (*Pinus Virginiana* Mill.) Forest Leaves, **8**: 152. Au 1902. [Illust.]

Rothrock, J. T. Mountain Ash. (*Pyrus Americana* DC.) Forest Leaves, **8**: 56. Au 1901. [Illust.]

Rothrock, J. T. Short-leaf Pine. Yellow Pine. (*Pinus echinata* Mill.; *Pinus mitis* Mich.) Forest Leaves, **9**: 24. Ap. 1903. [Illust.]

Rothrock, J. T. Slippery Elm. (*Ulmus fulva* Michx.) Forest Leaves, **8**: 136. Je 1902. [Illust.]

Rothrock, J. T. The Washington Thorn. (*Crataegus cordata* (Mill.) Ait.) Forest Leaves, **8**: 88. D 1901. [Illust.]

Rothrock, J. T. Water Beech, Hornbeam. (*Carpinus Caroliniana* Walt.) Forest Leaves, **8**: 40. Je 1901. [Illust.]

Rothrock, J. T. Wild Yellow or Red Plum. (*Prunus Americana* Marshall.) Forest Leaves, **8**: 88. D 1901. [Illust.]

Rusby, H. H. Vegetable Foods. Jour. N. Y. Bot. Gar. **4**: 176–186. O 1903.

Schuette, J. H. The Hawthorns of Northeastern Wisconsin. Proc. Biol. Soc. Wash. **16**: 91–97. 25 Je 1903.
Includes one new species.

Seemen, O. von. Three New Willows from the Far West. Bull. Torrey Club, **30**: 634–636. 4 N 1903.
Two new species of *Salix* from California and one from Nevada.

Small, J. K. The Habitats of *Polypodium polypodioides*. Torreya, **3**: 141. 26 S 1903.

Underwood, L. M. The Early Writers on Ferns and Their Collections. — I. Linnaeus, 1707–1778. Torreya, **3**: 145–150. 30 O 1903.

Van Tieghem, P. Quelques espèces nouvelles d'Ochnacées. Bull. Mus. Hist. Nat. Paris, **9**: 30–35, 73–89, 156–165. 1903.
Includes new Brazilian species in *Plicouratea* (3), *Ouratea* and *Trichouratea*.

Waters, C. E. Some Abnormal Flowers of the Wild Columbine. Plant World, **6**: 244, 245. *pl. 31*. O 1903.

Weber, A. Les Cactées de Costarica. Bull. Mus. Hist. Nat. Paris, **8**: 454–469. 1902. [Illust.]
New species and varieties are described in *Cereus* (9), *Phyllocactus* (5), *Rhipsalis* (2) and *Pereskia*.

Weber, A. Notes sur quelques Agaves du Mexique occidental et de la Basse-Californie. Bull. Mus. Hist. Nat. Paris, **8**: 218–224. 1902.
Includes descriptions of two new species, *Agave tequilana* and *A. Datylio*.

Wentworth, L. A. Two Plants New to the Flora of Lynn, Massachusetts. Rhodora, **5**: 256, 257. 13 O 1903.

Wilcox, E. M. Notes on Troublesome Insects and Plant Diseases. Oklahoma Agric. Exp. Sta. Rep. **10**: 112–128. *f. 1–5*. 1901.

Wildeman, E. de. *Helicteres ovata* Lamk. Ic. Sel. Hort. Thenensis, **4**: 53–56. *pl. 132*. Ap 1903.
Native of central Brazil.

Wildeman, E. de. *Polanisia trachysperma* Torr. et Gray. Ic. Sel. Hort. Thenensis, **4**: 49–52. *pl. 131*. Ap 1903.

Native of North America.

Wildeman, E. de. *Schaueria calycotricha* Nees ab Esenb. Ic. Sel. Hort. Thenensis, **4**: 87–90. *pl. 139*. Je 1903.

Native of Brazil.

Williams, F. N. On *Zygostigma*. Jour. Bot. **41**: 232–234. 1 Jl 1903.

Description of this South American genus of Gentianaceae and its two species.

Woolson, G. A. A New Station for *Asplenium ebeneum Hortonae*. Rhodora, **5**: 257. 13 O 1903.

GENERIC INDEX

Abies, 424
Abrodictyum, 681
Abutilon, 142
Acacia, 115, 305
Acer, 87, 505, 506, 509, 511, 512
Acerates, 289
Acetabula, 93
Acetabulum, 93
Achillea, 585, 615
Aconitum, 511
Acrolasia, 275, 277, 278, 281
Acrostichum, 673, 675, 679
Actinostachys, 671
Adiantum, 319, 320, 349, 350, 665, 676
Aecidium, 4–6
Aegilops, 147
Aesculus, 511
Agaricum, 112, 231
Agave, 294, 623–625
Agoseris, 310, 311, 501
Agrostis, 385
Agyropsis, 86
Ailantus, 510
Albatrellus, 426
Alcicornium, 672, 673
Aleuritopteris, 349
Allantodia, 677
Allium, 10, 12, 483, 484
Allophylaria, 88
Alsine, 250
Alsophila, 672
Amblystegium, 479
Ambrosia, 338, 585, 615, 618
Amelanchier, 582
Amianthium, 272
Ampelopsis, 511
Anapausia, 672, 679
Anastrophus, 371, 377
Andropogon, 294, 370, 372, 373, 378, 386, 572, 577, 578, 581, 582, 585, 588, 589, 598, 599, 616, 619, 620
Androsace, 260
Anemia, 346
Anemone, 145
Angiopteris, 669, 670
Anhalonium, 628
Anisogonium, 677
Anomodon, 471, 473, 474
Antennaria, 10, 294, 611, 615, 618
Anthephora, 370, 373
Anticlea, 272, 273, 280
Antrophyum, 674
Anychia, 328
Aquilegia, 134, 145
Arabis, 488–490
Arachis, 510
Aralia, 291
Archilejeunea, 553, 555
Arcypteris, 678, 679
Arenaria, 578
Ariocarpus, 622, 628, 633
Aristida, 371, 385–387
Aristolochia, 507, 511
Aronia, 580, 595, 619
Artemisia, 303, 307, 310, 578, 585, 611, 615, 617, 618
Arthonia, 414
Arthrostylidium, 372, 389
Arundinaria, 287, 288
Arundinella, 370, 373
Arundo, 388
Asclepias, 294, 339, 340, 578, 584, 608, 614, 619
Ascyrum, 175
Asparagus, 510
Asperula, 166
Aspidium, 357, 673, 678, 679
Asplenium, 291, 355, 356, 677, 678
Aster, 11, 309, 310, 584
Athyrium, 355, 356, 677, 678
Atriplex, 248, 510, 613
Aulospermum, 236
Azalea, 147, 584
Azolla, 681

Baccharis, 685–696
Bactrospora, 86
Baptisia, 336, 337, 339, 578, 582, 614, 619
Bartonia, 276–278
Bazzania, 545
Begonia, 145, 199–201, 204
Belvisia, 674, 675
Berberis, 582
Besseya, 279–281
Betula, 581, 582
Biatora, 414, 416, 417
Bicuspidaria, 275, 280
Bihai, 656, 655
Blechnum, 677, 678
Bletia, 143
Bolbitius, 97
Boletus, 110, 112, 117, 118, 226, 228, 230, 231, 297, 298, 425, 426
Boltonia, 323
Bommeria, 347
Botrychium, 42–55, 345, 669
Botrypus, 44

Bouteloua, 386
Boykinia, 181
Brasenia, 290, 325
Breweria, 289, 320
Bromus, 9, 175, 591
Bronnia, 451–453, 455
Bryophyllum, 198, 200, 205, 207, 503
Buellia, 414
Bumelia, 291
Bursa, 578

Cabomba, 290, 328
Cacalia, 342
Cactus, 303, 307
Calceolaria, 145
Callipteris, 677, 678
Caloporus, 426
Canna, 162
Cannabis, 133
Cantua, 449, 452
Carex, 11, 581, 585, 593, 594, 602, 617–619
Cassia, 605, 606, 617
Castalia, 290, 325, 329–331
Castanea, 294, 582
Castilleia, 85
Catopsis, 435
Ceanothus, 294
Cedrela, 299
Celastrus, 583
Celosia, 240
Cenchrus, 336, 371, 372, 384, 588, 591, 616
Cephalanthus, 291, 323
Cephalomanes, 681
Cerastium, 249, 250
Ceratiola, 284, 285
Ceratolejeunea, 547
Ceratopteris, 669, 671
Cercis, 292
Cereus, 146, 302, 304, 307
Chaetochloa, 371, 383, 384
Chaetosphaeria, 83
Chara, 175, 176
Cheilanthes, 347, 350–353, 676
Cheilolejeunea, 557
Cheiranthus, 308
Cheiropleuria, 673
Chelidonium, 10
Chenopodium, 247, 248, 510
Chloris, 372, 385, 386
Chorizanthe, 485, 486
Chrosperma, 271
Chrysanthemum, 585, 610, 611, 618
Chrysoma, 689
Chrysopsis, 289, 294, 584, 596, 610, 615, 618
Cibotium, 672
Cirsium, 145
Cistus, 143, 596
Cladonia, 579
Clarkia, 492
Clavaria, 98, 99
Clematis, 511
Cleomella, 249, 490
Clethra, 407
Closterium, 513
Cobaea, 165
Coix, 370, 372
Coleosporium, 14
Collema, 413, 416
Collinsonia, 340
Cololejeunea, 21, 34, 560
Comptonia, 579, 581
Coniogramme, 673, 677
Convolvulus, 495
Corispermum, 247
Cortinarius, 96
Corydalis, 10
Corylus, 511
Cosmarium, 514
Cotyledon, 145
Covillea, 303, 305, 623
Cracca, 294, 580, 583, 614
Crantzia, 405, 411
Crataegus, 10, 289, 320, 335
Crepis, 502
Crinum, 145
Crotalaria, 294, 582, 605, 617, 620
Crypsinus, 675
Cryptanthe, 236
Cryptogramma, 676
Cryptoporus, 423, 424
Cyamus, 329
Cyathea, 672
Cyclamen, 202
Cyclopeltis, 679
Cyclophorus, 674, 675
Cyclosorus, 678, 679
Cynoctonum, 294
Cynosurus, 387
Cyperus, 294, 321–323, 326, 577, 581, 585, 591, 592, 601, 617, 619, 620
Cyphella, 432, 433
Cypripedium, 604, 614
Cyrilla, 294
Cyrtolejeunea, 544, 552–557, 563
Cyrtomium, 679
Cytisus, 142
Cytosporella, 99

Dactyloctenium, 372, 387
Dalibarda, 273
Danthonia, 174, 175
Dasylirion, 622
Dasyscypha, 88, 89
Datura, 134, 142, 146
Davallia, 680
Dennstaedtia, 680
Dermatea, 87
Desmodium, 583
Diacalpe, 679

Dianthus, 134, 145, 147
Dicerandra, 324, 340
Dichromena, 326
Dicksonia, 672
Dicranopteris, 671
Dictyopteris, 678
Didymochlaena, 678, 679
Didymoglossum, 681
Diectomis, 370, 373
Digitalis, 134, 145, 146, 148
Digitaria, 378
Dimorphostachys, 371, 379
Diodia, 147, 289
Dioscorea, 292
Diospyros, 289, 335
Diplazium, 677, 678
Dipteris, 673, 678
Docidium, 513
Doryopteris, 676
Draba, 251
Drepanolejeunea, 19–41, 546, 555
Drosera, 150, 519, 532, 533
Drymoglossum, 674, 675
Drynaria, 674, 675
Dryopteris, 294, 344, 356, 678, 679
Dryostachyum, 674, 675
Duchesnea, 273
Duriaea, 216, 217
Duriella, 216
Durieua, 216

Echeveria, 452, 453
Echinocactus, 302, 303
Echinocereus, 303
Echinochloa, 371, 383
Echinocystis, 500
Edwinia, 84–86
Egenolfia, 672, 679
Elaphoglossum, 673
Eleocharis, 291, 294, 320, 321, 323, 326, 327
Eleusine, 372, 387
Elfvingia, 225, 296–301
Elliottia, 295
Elymus, 233
Endocarpon, 416, 417
Endolepis, 248
Enslinia, 432, 433
Ephedra, 307
Epilobium, 143, 145, 146
Equisetum, 158, 166, 307, 325, 630, 682
Eragrostis, 372, 388
Erica, 145
Erigeron, 11, 584
Eriochloa, 374
Eriogonum, 175
Eritrichium, 240
Eryngium, 294, 326
Erythrina, 292
Eschscholtzia, 487, 488
Euastrum, 514
Euonymus, 10
Euosmolejeunea, 544, 553, 555–559, 563
Eupatorium, 294, 338
Euphorbia, 9, 13, 328, 337, 583, 614, 629–633
Eurotium, 56
Eustachys, 372, 386

Faba, 510
Fabronia, 476
Fegatella, 205
Ferula, 16
Ficus, 104, 105
Fimbristylis, 580, 581, 593
Flammula, 96
Flourensia, 623
Fomes, 97, 110–112, 117–119, 225–232, 298–301, 423, 424
Fomitopsis, 225–228
Fouquiera, 458
Fouquieria, 449, 451–458, 623
Fragaria, 273, 582, 604
Frankenia, 623
Fraxinus, 226, 232, 494
Fritillaria, 484
Fuchsia, 145
Fucus, 166

Galanthus, 10
Galium, 143, 510
Ganoderma, 120, 225, 230, 300, 301
Gaylussacia, 584
Genista, 510
Gerardia, 320
Geum, 142, 143, 145, 147
Gilia, 261, 450
Gillenia, 511
Ginkgo, 442
Gladiolus, 145, 148, 150, 152, 156, 162, 519
Gleditsia, 232, 307
Gleichenia, 671
Gnaphalium, 615, 618
Goniophlebium, 675
Goniopteris, 678, 679
Gordonia, 330
Gorgoniceps, 86
Gossypium, 161
Graphis, 414
Gratiola, 294, 326
Grifola, 426
Guzmania, 436, 437
Gymnadeniopsis, 327
Gymnandra, 280
Gymnogramme, 347, 675, 677
Gymnopteris, 347, 679
Gymnosporangium, 7, 14
Gynerium, 372, 387
Gyrostachys, 328

Habenaria, 327
Hackelochloa, 370, 372

Harpalejeunea, 20, 544–552, 555, 556, 560, 562, 563
Helenium, 321
Helianthemum, 337, 338, 578, 583, 595, 615, 619
Heliconia, 641–664
Heliotropium, 262
Helminthostachys, 669
Helonias, 272, 273
Helotium, 88
Helvella, 94, 100
Hemionitis, 673, 677
Hemitelia, 672
Heppia, 416, 417
Hesperaloe, 626
Hesperaster, 276
Hesperis, 175
Heterobasidion, 227
Heterocladium, 477, 478, 480
Heteroplegma, 92
Heterosteca, 372, 386, 387
Heuchera, 294
Hibiscus, 134
Hieracium, 142
Hippeastrum, 145, 148
Histiopteris, 676
Holacantha, 307
Holcus, 383
Holwaya, 86
Homalocenchrus, 323
Humaria, 91
Humata, 680
Humulus, 133
Hydnum, 97, 98, 432
Hydrangea, 292
Hydrolea, 340
Hygrolejeunea, 562
Hymenocallis, 146
Hymenolepis, 674
Hymenophyllum, 681
Hypericum, 577, 583, 615
Hypnum, 465, 467, 475, 477
Hypolepis, 676

Ichnanthus, 371, 383
Idria, 451, 457–459
Ilex, 284, 580
Indigofera, 294
Ionactis, 584, 597, 610, 615, 618, 619
Iris, 327, 484, 485
Isachne, 369, 371, 377
Ischaemum, 384
Isoetes, 295, 320, 321, 359–362

Juglans, 144
Juncus, 294, 323, 326, 327, 342, 446–448
Jungermannia, 37
Juniperus, 109, 116, 117, 578, 581, 619

Kalmia, 294, 580, 584
Kaulfussia, 669
Kneiffia, 175
Koeberlinia, 623
Krameria, 336
Krynitzkia, 239, 246

Lachnocladium, 99
Lactuca, 614
Lahmia, 86
Lamium, 511
Lappula, 497
Larix, 10, 12, 163
Lathyrus, 491, 492, 507, 510, 692
Lavatera, 134, 163, 165, 166
Lecanopteris, 674, 675
Lecanora, 414, 415, 417, 418
Lecidea, 414
Lejeunea, 19, 20, 23, 25, 29, 30, 32–37, 544–549, 552, 553, 558, 560–562
Lemna, 175
Lepidium, 237, 253, 578
Lepiota, 95
Leptandra, 279, 692
Leptilon, 584, 611, 618
Leptochloa, 372, 387
Leptogium, 413
Leptolejeunea, 19–23, 555
Leptosphaeria, 85
Leptotaenia, 16
Leskea, 463–482
Leskia, 464
Lespedeza, 578, 583, 614, 619
Lesquerella, 252
Lilium, 163
Limnanthemum, 290, 325
Linaria, 147, 340, 584, 596, 609, 610, 615, 617
Lindsaea, 680
Linum, 134, 510
Liriodendron, 582
Lithospermum, 83
Lobelia, 134
Lolium, 175
Lomaria, 677
Lophidium, 671
Lotus, 254
Ludwigia, 291
Ludwigiantha, 291
Lupinus, 255–259, 390, 503, 580, 582, 583, 605, 614
Lychnis, 147
Lycium, 134, 306
Lycopodium, 202, 294, 326, 682
Lygodium, 670, 671
Lysimachia, 175, 584, 607

Macropodia, 91
Magnolia, 102, 103, 294
Maisonneuvea, 216
Malus, 112
Malva, 134
Manisuris, 372

Marasmius, 95
Marattia, 669
Marginaria, 346
Mariopteris, 443
Marsilea, 681, 682
Matthiola, 134
Mayaca, 324
Mecosorus, 671
Meibomia, 337, 578, 583, 606, 614
Melampsora, 9, 10, 12, 14
Melandrium, 134, 143
Melanthera, 292
Melanthium, 271, 273
Melia, 232
Meniscium, 678, 679
Mentha, 145, 692
Mentzelia, 275–278, 281
Mercurialis, 10
Meringium, 681
Mertensia, 261, 671
Merulius, 431
Mesadenia, 288, 342
Mesembryanthemum, 306
Metasphaeria, 84
Microlejeunea, 555, 556
Microlepia, 680
Milium, 374, 377
Mirabilis, 134, 146
Mitrula, 100
Mitruliopsis, 100
Monachne, 370, 374
Monachosorum, 673, 680
Monardella, 496, 497
Monniera, 325
Monogramma, 674
Montbretia, 144
Morchella, 99
Mucronoporus, 114
Musa, 655, 656
Mycobacidia, 86
Mycosphaerella, 84
Mycosphaerium, 84
Myrica, 407, 581

Nageiopsis, 445
Nama, 289, 340
Nasturtium, 175
Nelumbium, 329
Nelumbo, 290
Nemacladus, 500
Nemophila, 309
Neottiella, 89
Neottiopezis, 89
Nephrodium, 667, 679
Nephrolepis, 680
Nicotiana, 133, 134, 142, 145, 147
Niphobolus, 674
Nitella, 176, 177
Nolina, 626–628
Notholaena, 347–349, 672, 676
Nuphar, 329
Nymphaea, 289, 290, 329–331
Nyssa, 294, 580, 584

Odontosoria, 680
Oenothera, 75–82, 143, 175, 260
Oleandra, 679
Olneya, 306
Olyra, 371, 385
Omphalanthus, 556
Onagra, 76, 82, 607, 617
Onoclea, 357
Onychium, 676
Ophioderma, 669
Ophiogloea, 86, 87
Ophioglossum, 344, 345, 669
Oplismenus, 371, 383
Opulaster, 84
Opuntia, 303, 304
Orchis, 10
Oreobatus, 274, 275, 280
Oreocarya, 238–246
Ornithopteris, 346
Osmanthus, 338
Osmunda, 44, 46, 47, 50, 53, 54, 346, 670
Oxalis, 156, 682
Oxypolis, 403–411

Pachistima, 180
Pachylophus, 259, 260
Paesia, 676
Panicum, 290, 325, 327, 370, 371, 378–384, 581, 587, 597, 598, 618
Papaver, 145
Parkinsonia, 305
Parmelia, 413
Paronychia, 324, 328
Parthenocissus, 503
Paspalum, 294, 370, 374–377, 379, 381
Patinella, 86
Paxina, 93
Pedicularis, 84
Pelargonium, 145, 146
Pellaea, 353, 354
Penium, 514
Persica, 112
Pertusaria, 414
Peziza, 101, 432, 433
Phanerophlebia, 357
Pharus, 371, 385
Phaseolus, 292, 507, 511
Phegopteris, 678, 679
Phelline, 109
Phellinus, 109, 110, 112, 117
Philetaeria, 451, 453
Phleboscyphus, 93, 94
Pholiota, 95
Phorcys, 84
Photinopteris, 674, 675
Phragmidium, 14
Phragmites, 372, 388
Phryma, 340

Phycomyces, 202
Phyllocladites, 445
Phyllocladopsis, 444
Phyllocladus, 438–442, 444, 445
Phymatodes, 675
Physcia, 413, 415
Phytolacca, 338
Picea, 89, 90
Pinus, 10, 98, 106–108, 250, 289, 293, 294, 424
Piptoporus, 423–425
Pisum, 137, 151, 157–160, 507
Placodium, 414, 415, 417
Plagiochila, 39
Plagiogyria, 676
Plantago, 288, 341
Platanus, 582, 594, 615
Platycerium, 672
Platytaenia, 674, 675
Plectania, 100
Pleocnemia, 679
Pleosphaeria, 83
Pleospora, 85
Plicaria, 91, 92
Poa, 338, 577, 581, 585, 590, 600
Podocarpus, 441, 442, 445
Polybotrya, 672, 679
Polygala, 294, 323, 326
Polygonatum, 294, 602, 614, 620
Polygonella, 577, 582, 594, 614, 619
Polygonum, 323, 582, 604, 618, 620
Polymnia, 292
Polypodium, 151, 201, 346, 356, 667, 671, 673–675, 678, 679
Polyporus, 97, 110, 112–114, 116–120, 225–232, 297–301, 423–433
Polystichum, 357, 679
Polystictus, 227
Polytrichum, 579, 586
Pontederia, 325
Populus, 10, 12, 99, 143, 581
Poria, 112, 231
Porodiscus, 423, 432–434
Potentilla, 147, 582, 605
Protophyllocladus, 439–442
Prunus, 109, 112, 113, 335, 336, 504, 506, 507, 510, 511, 578, 582
Pseudoleskea, 478, 479
Psidium, 120
Psilothecium, 85, 86
Psilotum, 682
Pteridium, 350, 676
Pteris, 350, 676
Pterogonium, 473, 476, 478
Puccinia, 4–6, 8, 16
Pycnolejeunea, 557
Pyrenula, 413, 414
Pyrethrum, 507
Pyrola, 330
Pyropolyporus, 109–120
Pyrus, 507, 580

Quercus, 109, 115, 145, 284, 289, 294, 578, 579, 582, 619

Ramalina, 413
Ravenelia, 14
Rhexia, 294, 320, 323
Rhododendron, 143, 145–147, 181, 584
Rhus, 291, 327, 580, 583, 619
Rhynchospora, 282, 294, 320, 323, 324, 326
Ribes, 10, 110, 119
Richardsonia, 147
Riella, 214–224
Rimella, 216
Rinodina, 415
Robinia, 110, 114, 115, 294, 503, 510, 583
Rosa, 507, 511, 580
Rubacer, 274, 280
Rubus, 146, 273–275, 280, 507, 578, 582, 583, 585, 692
Rudbeckia, 289, 321
Rumex, 582

Sabal, 283
Sabbatia, 320, 338, 339
Sacciolepis, 371, 383
Saccoloma, 680
Sagenia, 679
Sagenopteris, 439
Sagittaria, 320, 321, 327
Salicornia, 613
Salisburia, 442
Salix, 86, 88, 145, 634–636
Salomonia, 602, 603, 614, 618, 620
Sambucus, 507
Samolus, 323
Saponaria, 578
Sarothamnus, 510
Sarothra, 577, 583, 595, 615, 618, 619
Sarracenia, 327, 331–335, 342
Sassafras, 582
Schistochila, 545
Schizachyrium, 370, 372
Schizaea, 671
Scindalma, 301
Scirpus, 322, 323, 325
Scleria, 294, 323
Scutellaria, 492–494
Scutellinia, 89, 90
Scutiger, 423, 425–432
Scytopezis, 87
Sedum, 306
Selaginella, 666, 682
Selliguea, 674, 675
Senebiera, 175
Senecio, 88
Sepedonium, 99
Sepultaria, 91
Serenoa, 324
Setaria, 384
Shepherdia, 226, 228

Sida, 507
Silene, 147, 487
Sinningia, 148
Sitanion, 233–235
Smilacina, 614
Smilax, 692
Solanum, 147
Solidago, 11, 584, 610, 618
Spartina, 580, 581, 585, 591, 601, 616, 620
Spathularia, 100
Sphacele, 495, 496
Sphaeria, 432, 433
Sphaerocarpus, 215, 217
Sphaerocionium, 681
Sphenopteridium, 443
Spiraea, 181, 407
Sporobolus, 289, 323, 371, 385, 577, 581, 589, 600, 616, 618–620
Spraguea, 486
Stanleya, 252
Staurastrum, 514
Stegania, 677, 678
Stenanthium, 271
Stenochlaena, 677, 678
Stenophyllus, 580, 581, 592, 601, 617, 619
Stenosemia, 679
Stenotaphrum, 371, 384
Stereum, 203
Stictis, 86
Stillingia, 323
Stipulicida, 324
Strepsilejeunea, 544, 560, 562
Strophostyles, 582, 583, 617
Struthiopteris, 677
Stylosanthes, 294
Symphoricarpos, 119, 497–500
Syngramma, 677
Syntherisma, 371, 378, 577, 581, 586, 619
Synthyris, 278–281
Syringa, 148, 152, 163, 511, 519, 525

Taenitis, 674, 675
Taxilejeunea, 562
Taxodium, 287, 290, 321
Tectaria, 357, 679
Teichospora, 84
Tephrosia, 583
Thalictrum, 83, 582
Thallocarpus, 215
Thamnopteris, 677, 678
Theloschistes, 413
Thelypodium, 253
Thinfeldia, 444
Thinnfeldia, 438–445
Thysanocarpus, 253
Tichosporium, 83, 84
Tiedemannia, 403
Tiedmannia, 403
Tillandsia, 435, 436
Tissa, 578
Tmesipteris, 682
Tolypella, 176
Torreya, 276
Touterea, 236, 275–277, 280
Toxicoscordion, 272, 273, 280
Trachylejeunea, 544, 545, 555, 560–563
Trachyphytum, 277
Trametes, 227, 230
Trautvetteria, 181
Triadenum, 290
Trichachne, 371, 378
Trichomanes, 681
Trichostema, 575, 577, 584, 609, 618–620
Trifolium, 254, 503, 507
Trillium, 294
Triphlebia, 677
Tripsacum, 373
Triticum, 147
Tritonia, 144
Tropaeolum, 143
Troximon, 502

Uniola, 372, 389
Urceolaria, 416, 417
Uredo, 4, 5
Urnula, 87
Uromyces, 13
Urtica, 507, 692
Usnea, 413
Utricularia, 325, 328
Uvularia, 294

Vaccinium, 294, 580, 584
Vagnera, 603, 614, 618
Veratrum, 271
Verbascum, 134, 145, 147, 584, 595, 596, 609, 615, 617
Vernonia, 294, 342
Veronica, 278, 279
Verrucaria, 417, 418
Viburnum, 294, 341, 342
Vicia, 507
Vincetoxicum, 178, 179
Viola, 10, 145, 292, 583, 607
Vittaria, 674

Waldsteinia, 180
Wislizenia, 490, 491
Woodsia, 357, 358
Woodwardia, 320, 354, 677
Wulfenia, 278–280

Xanthochrous, 114, 120
Xerophyllum, 181
Xolisma, 284
Xyris, 325, 326

Yeatesia, 292
Yucca, 84, 294

Zingiber, 642
Zygadenus, 271–273, 280, 483

1. HELICONIA TORTUOSA

2. HELICONIA BORINQUENA

HELICONIA CHAMPNEIANA

VOL. 30 DECEMBER, 1903 No. 12

BULLETIN

OF THE

TORREY BOTANICAL CLUB

EDITOR

JOHN HENDLEY BARNHART

ASSOCIATE EDITORS

NATHANIEL LORD BRITTON
DANIEL TREMBLY MACDOUGAL
TRACY ELLIOT HAZEN
WILLIAM ALPHONSO MURRILL
MARSHALL AVERY HOWE
HERBERT MAULE RICHARDS
ANNA MURRAY VAIL

CONTENTS

On Some Species of *Heliconia* (PLATES 29, 30): *Robert F. Griggs* 641
A Summary of our Present Knowledge of the Ferns of the Philippines: *Lucien Marcus Underwood* 665
Anatomy and Physiology of *Baccharis genistelloides*: *Elsie M. Kupfer* 685
INDEX TO RECENT LITERATURE RELATING TO AMERICAN BOTANY 697
GENERIC INDEX 705

PUBLISHED FOR THE CLUB

THE NEW ERA PRINTING COMPANY
LANCASTER, PA.

THE TORREY BOTANICAL CLUB

President,
HON. ADDISON BROWN, LL.D.

Vice-Presidents,
HENRY H. RUSBY, M.D. EDWARD S. BURGESS, PH.D.

Recording Secretary,
F. S. EARLE, A.M.
Botanical Garden, Bronx Park, New York City.

Corresponding Secretary,
JOHN K. SMALL, PH.D.,
Botanical Garden, Bronx Park, New York City

Treasurer,
FRANCIS E. LLOYD
Columbia University, New York City.

Meetings the second Tuesday and last Wednesday of each month alternately at the College of Pharmacy and the New York Botanical Garden.

PUBLICATIONS. Bulletin. Monthly, established 1870. Price $3.00 per year; single numbers 30 cents. Of former volumes only 1–6, 13, and 19–29 can be supplied entire. Partial numbers only of vols. 7–18 are available, but the completion of sets will be undertaken. Manuscripts intended for publication should be directed to John Hendley Barnhart, Editor, New York Botanical Garden, Bronx Park, New York City; all other correspondence to Francis E. Lloyd, Treasurer, Columbia University, New York City.

Torreya. Monthly, established 1901. Price $1.00 per year. Address the editor, Dr. Marshall A. Howe, New York Botanical Garden, Bronx Park, New York City.

Memoirs. Occasional, established 1889. (See last page of cover.)

Preliminary Catalogue of Anthophyta and Pteridophyta within 100 miles o New York City, 1888. Price $1.00. Address the Treasurer.

ISSUED JULY 22!

Flora of the Southeastern United States

By JOHN K. SMALL, Ph.D.

Being descriptions of the Flowering and Fern Plants growing naturally in North Carolina, South Carolina, Georgia, Florida, Tennessee, Alabama, Mississippi, Arkansas, Louisiana and the Indian Territory, and in Oklahoma and Texas east of the one-hundredth meridian, with analytical keys to the Orders, Families, Genera and Species, and the geographical distribution of each species.

Large octavo, pp. xii + 1382. Price $3.60 net. (Remit by P. O. or Express money order, or draft on N. Y.) Subscriptions may be sent to

DR. JOHN K. SMALL, Bedford Park, New York City.

The Warblers in Color

20 cents a number; $1.00 a year

PUBLISHED FOR THE AUDUBON SOCIETIES BY
THE MACMILLAN CO., 66 FIFTH AVE., New York City

BIRD LORE (Edited by FRANK M CHAPMAN) begins, in its December issue, the publication of a series of beautifully colored plates, drawn by Bruce Horsfall, accurately representing all the plumages of North American Warblers, with text from records in the Biological Survey giving the dates of migration of warblers at hundreds of localities.

This number, with a Christmas card of a before unpublished view of John Burroughs' cabin, "Slabsides," will be sent free to all subscribers to Vol. VI, 1904, of this Magazine. Or, on receipt of one dollar, we will send the magazine and the card inscribed with your name as donor of Bird-Lore for 1904, in time to be received as a

CHRISTMAS PRESENT

PUBLICATIONS

OF

The New York Botanical Garden

Journal of the New York Botanical Garden, monthly, illustrated, containing notes, news and non-technical articles of general interest. Free to all members of the Garden. To others, 10 cents a copy; $1.00 a year. [Not offered in exchange.] Vol. I, 1900, viii + 213 pp. Vol. II, 1901, viii + 204 pp. Vol. III, 1902, viii + 244 pp.

Bulletin of the New York Botanical Garden, containing the annual reports of the Director-in-Chief and other official documents, and technical articles embodying the results of investigations carried out in the Garden. Free to all members of the Garden; to others, $3.00 per volume. Vol. I, Nos. 1–5, 449 pp., 3 maps, and 12 plates, 1896–1900. Vol. II, Nos. 6–8, 518 pp., 30 plates, 1901–1903.

Memoirs of the New York Botanical Garden. Price to members of the Garden, $1.00 per volume. To others, $2.00. [Not offered in exchange.]

Vol. I. An Annotated Catalogue of the Flora of Montana and the Yellowstone Park, by Dr. Per Axel Rydberg, assistant curator of the museums. An arrangement and critical discussion of the Pteridophytes and Phanerogams of the region with notes from the author's field book and including descriptions of 163 new species. ix + 492 pp. Roy. 8vo, with detailed map.

Vol. II. The Influence of Light and Darkness upon Growth and Development, by Dr. D. T. MacDougal, first assistant and director of the laboratories. An account of the author's extensive researches together with a general consideration of the relation of light to plants. The principal morphological features are illustrated. xvi + 320 pp. Roy. 8vo, with 176 figures.

Contributions from the New York Botanical Garden. A series of technical papers written by students or members of the staff, and reprinted from journals other than above. Price, 25 cents each.

Vol. I. Inclusive of Nos. 1–25, vi + 400 pp. 35 figures in the text and 34 plates. $5.00.

CURRENT NUMBERS 25 CENTS EACH.

No. 41. The Polyporaceae of North America.—V. The genera *Cryptoporus*, *Piptoporus*, *Scutiger* and *Porodiscus*, by Dr. W. A. Murrill.

No. 42. A revision of the family Fouquieriaceae, by George V. Nash.

No. 43. Some correlations of leaves, by Dr. Daniel Trembly MacDougal.

No. 44. Soil-temperatures and vegetation, by Dr. Daniel Trembly MacDougal.

No. 45. Studies in plant-hybrids, by Dr. William Austin Cannon.

No. 46. Some aspects of desert vegetation, by Dr. Daniel Trembly MacDougal.

All subscriptions and remittances should be sent to

NEW YORK BOTANICAL GARDEN

BRONX PARK, NEW YORK CITY

PUBLICATIONS BY OFFICERS AND STUDENTS OF THE DEPARTMENT OF BOTANY, COLUMBIA UNIVERSITY

1. MEMOIRS OF THE DEPARTMENT:

Vol. 1. A Monograph of the North American Species of the Genus *Polygonum* (1895). By John Kunkel Small, Fellow in Botany, 1893–1895; Curator of the Herbarium, 1895–1898.

Quarto, 178 pages, 84 plates. Price $6.00.

Vol. 2. A Monograph of the North American Potentilleae (1898). By Per Axel Rydberg, Fellow in Botany, 1896–7.

Quarto, 224 pages, 112 plates. Price $6.00.

2. CONTRIBUTIONS FROM THE DEPARTMENT:

Vol. 1. Nos. 1–25. 1886–1892. Price $5.00.
Vol. 2. Nos. 26–50. 1892–1894. Price $5.00.
Vol. 3. Nos. 51–75. 1894–1895. Price $5.00.
Vol. 4. Nos. 76–100. 1895–1896. Price $5.00.
Vol. 5. Nos. 101–125. 1896–1897. Price $5.00.
Vol. 6. Nos. 126–150. 1897–1898. Price $5.00.
Vol. 7. Nos. 151–175. 1898–1901. Price $5.00.
Vol. 8. Nos. 176–200. 1901–1902. Price $5.00.
Vol. 9. Nos 201–. 1903–(current).

List of separate numbers available on application.

3. A Text-book of General Lichenology (1896). By Albert Schneider, Fellow in Botany, 1895–1896.

Octavo, 230 pages, 76 plates. Price $4.25 (cloth); $3.80 (paper). Published by Willard N. Clute & Co. Binghamton, N. Y.

The Department invites propositions relative to exchanges of herbarium material for any of the above named publications. Address Professor L. M. Underwood, Columbia University, N. Y. City.

4. An Illustrated Flora of the Northern United States, Canada, and the British Possessions from Newfoundland to the Parallel of the Southern Boundary of Virginia, and from the Atlantic Ocean westward to the 102d Meridian (1896–1898). By Nathaniel Lord Britton, Professor of Botany, 1891–1896; Emeritus Professor 1896–, and Hon. Addison Brown.

Three volumes, royal octavo. Vol. 1, 612 pages; Vol. 2, 642 pages; Vol. 3, 588 pages; 4162 figures in the text, illustrating every species described.

Published by Charles Scribner's Sons, New York. Price, in cloth, $9.00 for the three volumes; with the indexes and keys bound separately. $10.00.

5. Our Native Ferns and their Allies. (Sixth Edition) 1900. By Lucien Marcus Underwood, Professor of Botany, 1896–.

Duodecimo, 158 pages, 35 figures. Published by Henry Holt & Co., New York. Price $1.00.

6 Moulds, Mildews, and Mushrooms. By Lucien Marcus Underwood, Professor of Botany, 1896—.

Duodecimo, 236 pages, 10 plates. Published by Henry Holt & Co. Price $1.50.

7. A Text-book of General Botany (1897). By Carlton Clarence Curtis, Assistant in Botany, 1892-1895; Tutor in Botany, 1895–.

Octavo, 360 pages; 87 illustrations. Published by Longmans, Green & Co., New York. Price $3.00.

MEMOIRS OF THE TORREY BOTANICAL CLUB.

A series of technical papers on botanical subjects. Price, $3.00 per volume. [Not offered in exchange.] The following separate numbers supplied at prices named, which are strictly net:

Volume 1, No. 1.—Studies of the Types of various Species of the Genus *Carex*. By L. H. Bailey. Price, $1.00.

No. 2.—Marine Algæ of the New Jersey Coast and Staten Island. By Isaac C. Martindale. Price, 50 cents.

No. 3.—Hepaticæ Bolivianæ. An Enumeration of the Hepaticæ collected by Dr. H. H. Rusby in South America. By Richard Spruce. Price, 75 cents.

No. 4.—On Seedless Fruits. By E. Lewis Sturtevant. Price, 75 cents.

Vol. 2. No. 2.—Contributions to the Botany of Virginia. With two plates. By Anna Murray Vail and Arthur Hollick. Price, 75 cents.

No. 4.—The Genus *Polygala* in North America. By William E. Wheelock. Price, 75 cents.

Vol. 3. No. 2.—The Naiadaceæ of North America. With fifty-five plates. By Thomas Morong. Price, $2.00.

No. 3.—An Enumeration of the Plants collected in Bolivia by Miguel Bang. By Henry H. Rusby. Price, 50 cents.

Vol. 4. No. 1.—Index Hepaticarum. Part 1, Bibliography. By Lucien M. Underwood. Price, 75 cents.

No. 2.—Report on the Botanical Exploration of Southwestern Virginia during the Season of 1892. By John K. Small and Anna M. Vail. Price, 50 cents.

No. 3.—An Enumeration of the Plants collected in Bolivia by Miguel Bang—II. By Henry H. Rusby. Price, 50 cents.

No. 4.—*Arachis hypogaea*. With three plates. By A. S. Pettit. Price, 50 cents.

No. 5.—The North American Species of *Physalis* and related Genera. By P. A. Rydberg. Price, 75 cents.

Vol. 5. List of Pteridophyta and Spermatophyta of Northeastern North America. Prepared by the Botanical Club, A. A. A. S. Price, $3.00.

Vol. 6. No. 1.—An Enumeration of the Plants collected in Bolivia by Miguel Bang—III. By Henry H. Rusby. Price, $1.25.

No. 2.—A Revision of the North American Isotheciaceæ and *Brachythecia*. By Abel Joel Grout. Price, 50 cents.

No. 3.—The Life History of *Sphaerella lacustris* (*Haematococcus pluvialis*). With two colored plates. By Tracy Elliot Hazen. Price, 50 cents.

No. 4.—A Review of the Genera of Ferns proposed prior to 1832. By Lucien M. Underwood. Price, 50 cents.

No. 5.—Notes on the Lichen Distribution in the Upper Mississippi Valley. By Bruce Fink. Price, 25 cents.

Vol. 7. The Hepaticæ and Anthocerotes of California. With thirty-five plates. By Marshall Avery Howe. Price, $3.00.

Vol 8. No 1.—The Comparative Embryology of the Rubiaceæ. With fifteen plates. By Francis Ernest Lloyd. Price, $1.75.

No. 2.—The Lejeuneæ of the United States and Canada. With seven plates. By A. W. Evans. Price $1.00.

No. 3.—The Life History of *Vittaria lineata*. With nine plates. By Elizabeth G. Britton and Alexandrina Taylor. Price, 75 cents.

Vol. 9. Monograph of the Erysiphaceæ. With nine plates. By E. S. Salmon. Price, $3.00.

Vol. 10. History of Pre-Clusian Botany in its Relation to *Aster*. By E. S. Burgess. Price, $3.00.

Vol. 11. No 1.—The North American Sordariaceæ. With nineteen plates. By David Griffiths. Price $1.75.

No 2.—The Ulothricaceæ and Chaetophoraceæ of the United States. With twenty-three plates. By Tracy E. Hazen. Price, $1.75.

Vol. 12. No. 1.—Flora of New Providence and Andros (Bahama Islands). With nineteen plates. By Alice R. Northrop. Price, $1.50.

Address: **TORREY BOTANICAL CLUB,**
COLUMBIA UNIVERSITY, NEW YORK CITY.

ESTABLISHED 1851.

EIMER & AMEND,

MANUFACTURERS AND IMPORTERS OF

Chemicals and Chemical Apparatus,

205, 207, 209 & 211 Third Ave.,

Corner of 18th Street, NEW YORK.

SOLE AGENTS FOR THE UNITED STATES OF NORTH AMERICA, FOR

E. March's Sæline Chemical Stone Ware.

Schleicher & Schuell's Chemically Pure and Common Filter Paper.

Doctor C. Scheibler's Saccharometers (Polariscopes).

Prof. Jolly's Specific Gravity Balances, etc.

Le Brun F. Desmontes & Co., of Paris, Platinum.

H. Tronesdorff's C. P. Chemicals.

SPECIALTIES:—Bacterioscopical Apparatus, Normal Graduated Glassware, Porcelain from the Roval Berlin and Meissen Factories, Bohemian and German Glassware, Filter Papers, Agate Mortars, Pure Hammered Platina, Balances and Weights, Copperware, Bunsen's Burners and Combustion Furnaces, Apparatus and Chemicals for Sugar Chemists.

LABORATORY OUTFITS

FOR

FERTILIZERS, ASSAYERS, UNIVERSITIES AND COLLEGES

GLASS-BLOWING, ETCHING, GRINDING AND REPAIRING